SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER, 1930.

GENERAL PHYSICS.

3906. Density of Carbon Dioxide. D. le B. Cooper and O. Maass. *Canad. J. of Research*, 2. *pp.* 388–395, *June*, 1930.

Modifications are described by the Maass and Russel method for the determination of the densities of gases which permit an accuracy of about one part in 10,000. The determination has been made of the density of carbon dioxide at two temperatures and over a pressure range of 75 to 25 cm. of mercury. The mean value obtained for the molecular weight of carbon dioxide at zero pressure is $44 \cdot 0033 \pm 0 \cdot 002$, from which the atomic weight of carbon is found to be $12 \cdot 0033 \pm 0 \cdot 002$. AUTHORS.

3907. Aneroid Manometer for Low Pressures. E. A. Stewardson. *Journ. Sci. Instruments*, 7. *pp.* 217–221, *July*, 1930.

A description is given of a manometer of the deflecting membrane type, which is of very simple construction. It is sensitive to pressure differences of the order of 10^{-4} mm. of Hg, and has been found in practice to be very constant and reliable. AUTHOR.

3908. Crystal Clock. W. A. Marrison. *Nat. Acad. Sci., Proc.* 16. *pp.* 496–507, *July*, 1930.

The crystal clock consists essentially of a generator of constant frequency controlled by a quartz crystal resonator, with suitable means for producing continuous rotation controlled by it, to operate time-indicating and related mechanisms. Detailed particulars of the clock's construction are given. The total change of rate of the clock observed over a period of about 6 weeks was 0·14 sec. per day, the average variation being much less. A small ageing effect has been observed: this has decreased steadily. At present it is impossible to attribute the effect definitely either to the quartz crystal or some uncontrolled variable in the system. Advantages of the clock system—its independence of earth motions and slight changes of level, and also of gravitational and magnetic fields are briefly discussed. The mechanism can be continuously adjusted so that the time-indicating dial is always correct within very narrow limits. The clock rate may be adjusted by predetermined amounts. Applications of the clock are discussed. J. S. G. T.

3909. Surface Tension of Liquid Nitrous Oxide. E. L. Quinn and G. Wernimont. *Am. Chem. Soc., J.* 52. *pp.* 2723–2730, *July*, 1930.

Measurements between 30° C. and − 50° C. are made by the capillary-rise method, with the approximate correction $(h + r/3)$ in place of the observed rise h. With the exception of the value at 30°, which is very near the critical temperature, the results are represented to within $\pm 2 \cdot 5$ % by an equation, $\gamma = 72 \cdot 8(1 - T/311 \cdot 8)^{1 \cdot 26}$, of the type proposed by van der Waals (T is the absolute temperature). The internal pressure, as indicated by the value of $\gamma/v^{\frac{1}{3}}$ (v being the molecular volume), falls immediately above that of carbon dioxide; liquid nitrous oxide should, therefore, be only slightly better than liquid carbon dioxide as a solvent for the common solutes. L. V. C.

3910. Physical Properties and Constitution of Mineral Lubricating Oils. W. Bielenberg. *Zeits. f. phys. Chem.* 149. *Abt. A.* 1–2. *pp.* 42–50, *July*, 1930.

The molecular weight-refractive index diagram given by Kyropoulos [see Abstract 862 (1930)] requires a correction, which gives it a considerably altered appearance. The optical proof of the isoparaffin character of certain mineral lubricating oils thus loses to a large extent its foundation. T. H. P.

3911. Viscosity, Molecular Volume and Temperature. W. Herz. *Zeits. f. Elektrochem.* 36. *pp.* 454–455, *July*, 1930.

Examining standard data for the change of viscosity (η) and of density with temperature, the author shows that if L is the cube root of the molecular volume, the product $L\sqrt[18]{\eta}$ is constant over a wide range of temperature (20° C. to 200° C.), lying between 3·15 and 3·51 for the substances benzene, ethy acetate, carbon tetrachloride, chlorbenzene and fluorbenzene, and ethyl ether. The relation is shown consistent with previous observations that $LT^{-\frac{1}{6}}$ and ηT^3 are approximately constant quantities. L. V. C.

3912. Variation of Viscosity of Liquids with Temperature. E. W. Madge. *J. Phys. Chem.* 34. *pp.* 1599–1606, *July*, 1930.

The theoretical relationship between viscosity η and temperature T is approached by way of Maxwell's conception of a " relaxation time " τ (determining viscosity in terms of the rate of response of a liquid to shearing stress), which conception is applied to Debye's theory of polar liquids. Reference is made to experiments which indicate the occurrence of flow orientation in dipolar liquids, the rate of orientation depending on the relaxation time. Orientation is also produced in measurements of the dielectric constant in alternating fields, the constant passing through a maximum value at a critical frequency, which elicits a sort of resonance from the dipoles. Utilising Debye's equation for this critical frequency, in conjunction with Tilleard's equation (as yet unpublished), $E = Ae^{\beta T}$, connecting the rigidity E with the temperature, the author derives the relation, $\eta = Ae^{\beta T}/(T - b)$, A, b and β being constants. Calculated and observed values of η for a number of simple organic liquids agree well over wide ranges of temperature. L. V. C.

3913. Viscosity Coefficients of Liquids. R. O. Herzog. *Zeits. f. phys. Chem.* 149. *Abt. A.* 1–2. *pp.* 89–96, *July*, 1930.

The corrected molecular radius obtained from Einstein's equation for the diffusing substance can be expressed as $\sim \frac{1}{2}\{(v - b)/N\}^{\frac{1}{3}}$. Introducing into Einstein's equation the " coefficient of self-diffusion " deduced from the diffusion coefficient of an isomeric liquid, and the value obtained as above for the molecular radius, an expression is derived for the viscosity of the liquid, $\eta = 2P\,.\,t/3\cdot 7\pi$, where P is the internal pressure and t the molecular displacement time. A. J. M.

3914. Margules Method of Measuring Viscosities Modified to Give Absolute Values. H. R. Lillie. *Phys. Rev.* 36. *pp.* 347–362, *July* 15, 1930.

A method for determining absolute viscosities in a Margules rotating cylinder viscometer, without the aid of calibrating liquids of known viscosities, is described. This method involves the determination of true viscosity by extrapolating apparent viscosities for several lengths of the inside cylinder to that viscosity corresponding to infinite length. By this method the viscosity of the commercial castor oil used is found to be 9·99 poises at 20° C. and 4·61 at 30° C., as compared with 9·86 and 4·51 poises quoted in the Smithsonian Tables for pure oil at corresponding temperatures. The additional length to be applied to the measured length to correct for finite dimensions is computed for several inside cylinders or spindles. When the radius of the outer containing cylinder is 3·2 cm., and the ends of the spindle are 1·5 cm. from the upper and lower boundaries of the liquid, the corrections for spindle radii of 0·556 and 0·477 cm. are found to be 0·62 and 0·52 cm. respectively as long as the length of the spindle is 5 cm. or greater. Accordingly, the end correction is apparently proportional to be 1·18 power of spindle radius. Comparisons are also made between relative viscosities measured by this method and those for the same liquids measured by capillary flow. The results indicate that within experimental error these relative values are the same by both methods for viscosities between 5 and 3500 poises, showing that the calibrating factor of the concentric cylinder system is constant over this range of viscosities. AUTHOR.

3915. Motion of a Solid Body in a Liquid with Friction. H. Benndorf. *Phys. Zeits.* 31. *pp.* 593–610, *July* 1, 1930.

The first part of this paper contains a proof that the Exner resistance formula [see Abstract 24 (1930)], which was based upon energetic considerations, is invalid. The second part studies the motion of a sphere in a friction liquid under the action of a constant force, and is divided into the following sections: equations of motion; limiting velocity of spheres; damping of spheres in motion; fall motion of spheres; consideration of the co-motion of the liquid; application to other forms of body. The paper is entirely mathematical, and replete with numerical examples and illustrative diagrams. H. H. Ho.

3916. Flow in a Channel. H. Poncin. *Comptes Rendus*, 191. *pp.* 17–20, *July* 7, 1930.

This entirely mathematical paper considers the flow of a fluid in a channel enclosed between two parallel walls and a floor of a form asymptotic at infinity to two horizontal planes of fixed dimensions. H. H. Ho.

3917. Formation of Waves at the Surface of Liquids. J. Baurand. *Comptes Rendus*, 191. *pp.* 20–21, *July* 7, 1930.

The author has previously shown [see Abstract 2898 (1928)] that the waves which are propagated at the surface of water become deformed, and a photographic study of their mode of formation is now described in detail. H. H. Ho.

3918. Auto-Oscillation and Auto-Rotation of Immersed Plates. J. Courrègelongue and H. Maugein. *Comptes Rendus*, 191. *pp.* 90–92, *July* 16, 1930.

This paper continues previous work [see Abstract 2390 (1930)], and discusses special cases of oscillation and rotation of immersed plates from the hydrodynamics involved. H. H. Ho.

3919. Baricentric Moments of the Quantity of Motion in a Material System. F. Lamberti. *Accad. Lincei, Atti,* 11. *pp.* 969–974, *May* 30, 1930.

Referring to the method of calculation described by Stokes in his paper on the friction of fluids in motion, the author introduces a new artifice differing from that of Stokes and of the type of those used in the systems called ametamorphic previously described by the author [*ibid.* 10. p. 336, Oct., 1929]. J. J. S.

3920. Pulsating Flow of Gases at Very Low Frequencies. Z. Carrière. *J. de Physique et le Radium,* 1. *pp.* 217–234, *July,* 1930.

Pulsations of frequency about 1 per sec. are produced within a special double resonator, in the form of a cross, which is supplied with air at a pressure of a few cm. of water. When air flows into the resonator by one arm, through a narrow jet, the opposite arm being closed, an alternating air-current is set up which is, at any instant, unidirectional in the two cross-arms. The apparatus and experiments are modified to investigate the effects of different factors on the frequency of these pulsations, and it is found, for example, that, except at very low pressures, the frequency increases as $\sqrt{\text{pressure}}$, *i.e.*, as the speed of the gas emerging from the jet. The speed of sound does not enter at all, as a factor controlling the frequency, and the theory of these pulsations or pressure waves may be based on that of stationary waves in shallow water. G. E. A.

3921. Diffusion Mechanism in Solids. Gold in Silver. W. Jost. *Zeits. f. phys. Chem.* 9. *Abt. B.* 1. *pp.* 73–82, *July,* 1930.

An alloy of gold and silver is blackened by $(NH_4)_2S$, when it contains more than a certain minimum amount of gold. The property has already been employed by Fraenkel and Houben in measuring the rate of diffusion of gold in silver. The author silvered a gold foil about 0·3 mm. thick electrolytically, determining the thickness of the silver layer from the current and time of flow, and also by weighing. The foil was raised to the desired temperature, and pieces were cut off from time to time and tested with ammonium sulphide on the silver surface until blackening was observed, indicating the diffusion of about 6 mol. % of gold through the silver film. The method is not particularly accurate, and in unfavourable cases the error may reach 50 %. Experiments were made at a number of different temperatures from 878° C. down to 218° C., and with thicknesses varying from 3×10^{-3} cm. for the highest temperature down to 10^{-6} cm. for 218° C. The values of log D (D = velocity of diffusion) plotted against $1/T$ (T = temperature) lie practically on the same straight line as those obtained by Braune, using higher temperatures and much thicker layers of silver. The velocity of diffusion is thus independent of the thickness of the layer, and Smekal's view that the diffusion is due, not to ions in the lattice but to "loose" ions, is excluded. H. N. A.

3922. Experimental Measurement of Internal Forces in Solids. A. Mesnager. *Rev. d'Optique,* 9. *pp.* 241–246, *June–July,* 1930.

Double refraction produced by strain is employed to measure experimentally internal elastic forces in two dimensions, and to determine their maxima. C. B. A.

3923. Effect of Variation of Density on the Propagation of Surface Waves on an Elastic Solid. R. Stoneley. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 103–110, *July,* 1930.

The present paper is a discussion of the influence on the velocity of Love waves of a linear increase of density with depth, the rigidity remaining constant. Guidance is given by the phenomenon of total internal reflection, which presents an analogy to the present problem. Two distributions are discussed. For a solid of constant rigidity in which the density increases linearly with the depth, no wave of the Love type can exist. For a layer of such material lying on uniform material in which the velocity of distortional waves is greater than in any part of the layer, wave-velocity equations are obtained to cover the three cases that arise. These are discussed for very long and very short waves respectively, when it is shown that waves can exist only if the velocity of the Love wave is greater than the velocity of distortional waves at any point in the layer. H. H. Ho.

3924. Dynamic Adiabatic Law Relative to Elastic Surfaces. L. Roy. *Comptes Rendus*, 191. *pp.* 12–14, *July* 7, 1930.

This mathematical paper continues a previous investigation [see Abstract 3630 (1930)] of the study of the adiabatic propagation of impact waves on elastic surfaces, and by means of the principle of equivalence derives a dynamic adiabatic law for elastic non-viscous surfaces of six parameters. H. H. Ho.

3925. Structure of Sodium and Calcium Aluminosilicates. L. Pauling. *Nat. Acad. Sci., Proc.* 16. *pp.* 453–459, *July*, 1930.

On the assumption [see Abstract 2672 (1929)] that the silicon and aluminium atoms are at the centres of tetrahedra the corners of which are occupied by oxygen (Si—O and Al—O being respectively 1·60 and 1·74 Å.), and that corners but not edges of these tetrahedra are shared, structures agreeing well with the observed dimensions, cleavages and other properties are figured for; (i) Natrolite—(*a*) 18·19; (*b*) 18·62; (*c*) 6·58, unit cell $8(Na_2Al_2Si_3O_{16} . 2H_2O)$, lattice face-centred, space group C_{2v}^{19}, the tetrahedra form " strings," between which are the Na^+ ions and water molecules, which latter can escape along " channels " between the " strings." Scolecite has probably a similar structure. (ii) Scapolites (regarded as solid solutions of marialite and meionite)—(*a*) 12·72; (*c*) 7·66, lattice body-centred, unit cell 2 molecules, space group C_{4h}^5, C_4^5 or S_4^2, the structure suggested (space group C_{4h}^5) gives calculated intensities agreeing well with those observed. (iii) Davynite and cancrinite, the structure has a fundamental unit of 6 tetrahedra, and contains " tunnels " along the *c*-axis. C. A. S.

3926. Structure of Silicates. W. L. Bragg. *Zeits. f. Krist.* 74. 3–4. *pp.* 237–305, *July*, 1930.

The silicates are distinguished from other classes of inorganic compounds, which may be regarded as combinations of metal and acid radicles, by the way in which SiO_4 groups can be linked together to form Si—O complexes with indefinite extension in space. Any linking between Si atoms in silicates is always effected through an O atom. In the ortho silicates Si forms the group SiO_4, and in some other cases more complex groups which form discrete acid radicles linked with the metal ion as in other inorganic compounds. In all the structures which have been examined Si is found between four O atoms, the distance between Si and O being about 1·62 Å., and that between O centres about 2·6 Å. The whole group behaves as if a charge 4*e* were distributed equally among the 4O atoms. In the ortho silicates the SiO_4 groups are independent; in other silicates they are linked by one O atom being held in common. These linking O atoms have no residual valency, while those O atoms which are attached to only one Si atom behave as if they had a charge — *e*. The single charge on these, together with the charges on other ions O'', OH', F', are neutralised by the metallic ions. A number of types of Si complexes are distinguished: (*a*) Self-contained groups, represented by the formulæ $(Si_2O_7)^{6-}$, $(Si_3O_9)^{6-}$, $(Si_4O_{12})^{8-}$, $(Si_6O_{18})^{12-}$, such groups being regarded as complex acid radicles linked by metal ions as in a salt (*b*) Si—O chains as found in the pyroxenes (row of linked tetrahedra) and the amphiboles (double row of linked tetrahedra). (*c*) Si—O sheets, which are supposed to be characteristic of the scaly-like micas. (*d*) Three dimensional Si—O networks as in the forms of silica. The most general description of the silicate structures is one of Si—O complexes, which come together so that their large O atoms form with each other more or less regular groups into which the metal atoms are packed and bind the whole structure. Al can partly replace the Si atoms in the complex groups. When a silicate is analysed its composition should be expressed on the basis of a constant number of O atoms characteristic of the structure type. Pauling has evolved a rule of packing giving precision to an earlier idea of the author. This rule is, broadly stated, that the positive ions are so dispersed among the negative that local neutralisation of electric charge is effected throughout the structure. The structure may be regarded either as due to the balancing of electrostatic forces or to the assumption of that configuration corresponding to least energy. J. E.

3927. Quantitative X-Ray Analysis of the Structure of Potassium Dihydrogen Phosphate (KH_2PO_4). J. West. *Zeits. f. Krist.* 74. 3–4. *pp.* 306–362, *July*, 1930. *In English.*

The treatment is based on experimental work with the ionisation spectrometer and on photometric measurements of powder photographs. The parameters are determined directly by the application in successive stages of the method of double Fourier analysis [see Abstract 2921 (1929)]. Experimental F curves for potassium, phosphorus and oxygen are deduced and compared with the corresponding theoretical curves, allowance being made for the heat motion in the crystal. An additional method, particularly applicable to crystals of high symmetry, of determining the extinction coefficient in single crystals is described. The structure deduced agrees with that proposed by S. B. Hendricks, except that the shape of the PO_4 group is now found to be sensibly regular (tetrahedral) and the potassium atom is equidistant from its eight neighbouring oxygen atoms. Probable positions for the hydrogen atoms are suggested. J. E.

3928. Structure of Chromium Trichloride. Nora Wooster. *Zeits. f. Krist.* 74. *pp.* 363–374, *July*, 1930. *In English.*

The chromic chloride examined was in the form of soft hexagonal plates, never more than 0·005 and averaging 0·002 mm. thick; refractive index 1·63–1·64; density 2·87; with slight indications of dichroism. Examination was by means of Laue, rotation and oscillation photographs, and the ionisation spectrometer, with Cu and Mo radiation. Chromic chloride is a layer lattice, the underlying lattice being Γ_h, and the space group D_3^3 or D_3^5. The unit cell (orthogonal) has *a* 17·3 ± 0·1 Å., *c* 6·02 ± 0·05 Å., and contains six molecules. The chlorine ions are in cubic close packing; each chromium ion is surrounded by six chlorines at the corners of an octahedron, and each chlorine is directly bound to two chromiums. The distance Cr–Cl is 2·38 Å., Cl–Cl 3·25 and 3·85 Å. Coordinates of the 24 atoms in, and a stereoscopic view of, the unit cell are given. C. A. S.

3929. Atomic Distances in Crystals of Tetrahedral Structure. K. F. Niessen. *Phys. Zeits.* 31. *pp.* 610–616, *July* 1, 1930.

The distance between atoms in crystals of the diamond type is very nearly the same as that in crystals of the wurzite type if in the latter the component elements are drawn from the same horizontal series of the periodic table, as the single element in the former. The "wurzite" distance is a little greater than the "diamond" distance, the discrepancy increasing with the square of u, the number of places by which the wurzite components are removed from the fourth column in the periodic table. Assuming the external electrons of the components in the wurzite type, to be separated from the atom, the remainders of the atoms will act like nuclei of positive charges p_1e and p_2e, where $4 - p_1 = u = p_2 - 4$ $(p_2 > p_1)$. The attractive forces between these will be greatest for $u = 0$, that is neglecting changes in the forces due to the electrons, the atom distance should be greatest in the diamond type $(u = 0)$. The effect of the forces due to the electrons is worked out on the basis of wave mechanics, and is found to produce a change in the opposite direction so that on the whole the atom distance increases with u and approximately as u^2, in accordance with the experimental facts. W. S. S.

3930. α- and β-Crystals of Fatty Acids. J. Thibaud and F. D. la Tour. *Comptes Rendus*, 191. *pp.* 200-202, *July* 28, 1930.

The lozenge-shaped β-crystals of stearic acid [see Abstract 3015 (1930)] belong to the monoclinic system, and possess a plane of symmetry normal to the plane faces and passing through the bisectrix of the obtuse angle of these faces. With α-crystals of palmitic acid, also monoclinic, the plane of symmetry passes through the bisector of the acute angle of the lozenge. Both crystals also are moderately strongly birefringent. X-ray measurements show that the bases of the unit cells are rectangles with the sides 9·36 and 4·95 Å. for the α-palmitic acid crystals, and 5·65 and 7·36 Å. for β-stearic acid crystals; the angles of the lozenge are 55° 45, and 75° respectively for the two crystals. T. H. P.

3931. X-Ray Investigation of Methylcellulose. H. Mark and G. v. Susich. *Zeits. f. phys. Chem.* 9. *Abt. B.* 2. *pp.* 157–159, *July*, 1930.

A repetition of the work of Hess and Trogus on the X-ray analysis of methylcellulose [see Abstract 43 (1930)] shows that the two periods of identity of the elementary cell reported by these investigators, of 21·3 and 25·6 Å., rest upon a misinterpretation of their experimental data. Rotation photographs give as the length of the periodicity along the rotation axis the value of 10·3 ± 0·2 Å. [See also following Abstract.] F. J. W.

3932. X-Ray Fibre Diagrams of Trimethylcelluose and Triacetylcellulose. Part II. K. Hess and C. Trogus. *Zeits. f. phys. Chem.* 9. *Abt. B.* 2. *pp.* 160–168, *July*, 1930.

The criticism of Mark and v. Susich (see preceding Abstract) is accepted. The minimum value of the period of identity along the axis of a fibre of cellulose acetate is 10·7 ± 0·1 Å. F. J. W.

3933. Forms of Zirconium Dioxide. W. M. Cohn and Sibylle Tolksdorf. *Zeits. f. phys. Chem.* 8. *Abt. B.* 5–6. *pp.* 331–356, *July*, 1930.

Three different crystalline forms of zirconium dioxide are shown to exist. They have different temperature ranges. The forms were discovered by means of X-ray powder- and rotating-crystal-photographs: one is a monoclinic crystal; the second a tetragonal; and the third is either a trigonal or a pseudo-hexagonal. Their lattice-constants and densities are given. It is shown that the modifications of ZrO_2 are very similar to those of the chemically homologous SiO_2 and TiO_2. G. C. McV.

3934. Experimental Investigation of Brownian Movement. E. Samuel. *Ann. d. Physik*, 5. 6. *pp.* 677–700, *July* 7, 1930.

The object of the research is to test the theoretical law of the motion, which was observed by means of an ultramicroscope, the substances experimented with being gold and silver hydrosols. The radius of a particle is expressed in terms of the viscosity of the sol, and the measurements do not agree with the theoretical values. The cause of this discrepancy is discussed. G. E. A.

3935. Nitrogen Isotope of Mass 15. G. Herzberg. *Zeits. f. phys. Chem.* 9. *Abt. B.* 1. *pp.* 43–48, *July*, 1930.

The presence of the isotope of mass 15, first found by Naudé in NO bands, has been established in the second positive group. The measured isotopic displacement is smaller than the calculated amount, indicating a different packing effect for the two isotopes. The intensity-ratio is about 1 : 800. No trace was found of an isotope N^{16}, which is theoretically expected. F. S.

3936. Isotopes of Nitrogen and Oxygen. S. M. Naudé. *Phys. Rev.* 36. *pp.* 333–346, *July* 15, 1930.

The absorption spectrum of the NOγ bands was examined for isotopes of nitrogen and oxygen, particularly that of mass 15 for nitrogen, and those of 17 and 18 for oxygen. Band heads were observed corresponding to the four kinds of molecules, $N^{14}O^{16}$, $N^{15}O^{16}$, $N^{14}O^{17}$ and $N^{14}O^{18}$, thereby providing new evidence for the existence of the nitrogen isotope of mass 15, and verifying the existence of the oxygen isotopes of mass 17 and 18. Babcock [see Abstract 58 (1930)] gave the relative abundance of O^{16} and O^{18} as 1250. The present results, which appear more accurate, give this as 1075 ± 110. The relative abundance of N^{14} and N^{15} is 700 ± 140. From these relative abundance values the mass of the O^{16} isotope is estimated to be $15 \cdot 9980 \pm 0 \cdot 0002$, and the mass of the N^{14} isotope as $14 \cdot 0069 \pm 0 \cdot 0012$, which closely agrees with Aston's corrected value of $14 \cdot 0063 \pm 0 \cdot 0029$. R. C. F.

3937. Analytic Atomic Wave Functions. C. Zener. *Phys. Rev.* 36. *pp.* 51–56, *July* 1, 1930.

The wave functions for the atoms Be, B, C, N, O, F, Ne, are written as simple analytic expressions with several parameters. The best values of these parameters are then determined by the variation method. In the final wave functions the effective quantum number is very nearly two, the radial node is so small as to have little effect upon the charge distribution, the coefficient in the exponential is related to an empirical " mean effective charge." [See also following Abstract.] AUTHOR.

3938. Atomic Shielding Constants. J. C. Slater. *Phys. Rev.* 36. *pp.* 57–64, *July* 1, 1930.

In analogy with the method of Zener for the atoms from Li to F [see preceding Abstract], simple rules are set up giving approximate analytic atomic wave functions for all the atoms in any stage of ionisation. These are applied to X-ray levels, sizes of atoms and ions, diamagnetic susceptibility, etc. In connection with ferromagnetism it is shown that if this really depends on the existence of incomplete shells within the atoms, rather far apart in the crystal, then the metals most likely to show it would be Fe, Co, Ni, and alloys of Mn and Cu (Heusler alloys). AUTHOR.

3939. Annihilation of Electrons and Protons. P. A. M. Dirac. *Cambridge Phil. Soc., Proc.* 26. *pp.* 361–375, *July*, 1930.

Referring to his previous paper [see Abstract 2416 (1930)] the author proceeds to calculate the frequency of occurrence of the processes of annihilation of electrons and protons. The large difference between the masses of the proton and electron which seems to be connected with the interaction between electrons forms an unsolved difficulty. Therefore the interaction is neglected and the electron and proton treated as if of the same mass. Thus there is a serious deficiency in the work which detracts from the physical importance of the result; but the calculation is of interest and will presumably form the basis for future calculations which take the interaction correctly into account. Incidentally the calculation provides a justification for the scattering formula of Klein and Nishina.

J. J. S.

3940. Exchange Phenomena in the Thomas Atom. P. A. M. Dirac. *Cambridge Phil. Soc., Proc.* 26. *pp.* 376–385, *July*, 1930.

In Thomas' atomic model [see Abstract 1276 (1927)] the electrons are regarded as forming a perfect gas satisfying the Fermi statistics and occupying the region of space of lowest energy. In this paper the author examines the electron distribution in the state of lowest energy of an atom, for which a certain region of phase space is occupied with the maximum density of electrons and the remainder is empty. It is found that the equation governing the boundary between the occupied and unoccupied phase space is just that of Thomas' model, with a small extra term representing the exchange effect. In this way a theoretical justification is obtained for Thomas' model, and the correction which must be made in it to allow for exchange is found. J. J. S.

3941. Interpretation of the Principle of Causality in Quantistic Mechanics. E. Fermi. *Accad. Lincei, Atti*, 11. *pp.* 980–985, *May* 30, 1930.

The author discusses the question of how far it is possible according to quantistic mechanics to speak of causality, and in what sense should be understood the affirmation that quantistic mechanics does not lead to a determination of the future events. The object is not so much to give new results as to express in a new form relations already known. For clearness the discussion is limited to the case of a point moving along a straight line, but the extension to the case of more complicated systems is easy. The following conclusions are deduced by the author: All that it is possible to know of the state of a system at a given instant by means of experiments made at that instant it is possible to know also by means of suitable experiments made at any instant preceding or following that which is considered. In this sense then the indetermination of the system does not go on so to speak increasing with passage of time. It would be wrong, however, to conclude from this that the relations of causality valid according to quantistic mechanics are identical with those that hold good in the classical theories. In these last it is possible in fact with suitable measurements made on the system at zero time to foresee the value of any physical magnitude at any time. Instead, according to quantistic mechanics, it is possible at time zero to make a measurement that permits of knowing the value that a determined magnitude will have at a determined time. Yet if it should be desired to know the value of another physical magnitude or eventually even of the same magnitude at a different instant it would be necessary to effect at the zero instant a different measurement, incompatible, at least in general, with the preceding. J. J. S.

3942. Dirac's Equation. The Sixteen Components ψ_k. A. Proca. *Comptes Rendus*, 191. *pp.* 26–29, *July* 7, 1930.

The general solution for ψ written in the system of quadriquaternions employed by the author is $\psi = \psi_0 + \psi_1\epsilon_1 + \ldots + \psi_{12}\epsilon_1\epsilon_2 + \ldots + \psi_{123}\epsilon_1\epsilon_2\epsilon_3 + \ldots \psi_{1234}\epsilon_1\epsilon_2\epsilon_3\epsilon_4$. The components $(\psi_1, \psi_2, \psi_3, \psi_4)$ and $(\psi_{234}, \psi_{341}, \psi_{421}, \psi_{123})$ are transformed as vectors, $(\psi_{12}, \psi_{23}, \psi_{31}, \psi_{14}, \psi_{24}, \psi_{34})$ form an antisymmetrical tensor of the second order, ψ_0 and ψ_{1234} are invariants. The author's ψ is then not a "demi-vector"; its components obey known laws of transformation. They can be grouped as above into sets of elements, the physical interpretation of which can be attempted. It is shown that it is natural to suppose that ψ_1, ψ_2, ψ_3, belong to the moments p_x, p_y, p_z; ψ_4 to the energy or to E/c; ψ_{1234} to the mass or to mc; $\psi_{12}, \psi_{23}, \psi_{31}, \psi_{14}, \psi_{24}, \psi_{34}$, are magnitudes attached to the total proper moment of the electron; ψ_0 is related to x_5 the conjugate coordinate of the mass, or what is the same thing to the length of the de Broglie wave; ψ_{123}; $\psi_{234}, \psi_{341}, \psi_{412}$, to the space time coordinate. The author insists on the perfect symmetry of his expression. [See also Abstract 3647 (1930) and the following one.] H. N. A.

3943. Dirac's Equation. A. Proca. *J. de Physique et le Radium*, 1. *pp.* 235–248, *July*, 1930.

Treats fully the new form of Dirac's equation with sixteen scalar components dealt with in previous papers [see preceding Abstract]. Treating the problem thus with complete generality most of the objections raised to Dirac's equation vanish. The equation is written in invariant form with respect to Lorentz transformations, and is perfectly symmetrical. ψ is the wave function, which is determined by the equation $F\psi = 0$, where F is a quadriquaternion. This new Dirac equation is equivalent not to four differential equations, but to sixteen, the product $F\psi = (e_1t_1 + e_2t_2 + e_3t_3 + e_4t_4 + e_5t_5)(\psi_1e_1 + \ldots + \psi_{16}e_{16}) = 0$ being formed, using the laws of multiplication for hypercomplex numbers. The differential equation $\frac{\partial\psi_{14}}{\partial x_1} + \frac{\partial\psi_{24}}{\partial x_2} = \frac{\partial\psi_{34}}{\partial x_3} + \frac{\partial\psi_0}{\partial x_4} + \frac{2\pi i}{h} m_0c\psi_{123} = 0$, and fifteen other similar equations are obtained. Introduces the idea of a fifth dimension, the mass being regarded as a moment, having a conjugated variable, the de Broglie wave-length λ. The coordinates of the five dimensions are then x, y, z, ct and λ. Considers the nature of the quantities ψ_k which are hypercomplex probabilities. Each element which determines an electron has its own proper probability function ψ_k. ψ contains in a certain sense all the probabilities affecting the electron and is a hypercomplex number. Finds the components of the quadridimensional current, and obtains the equation of continuity. Here it is assumed that the mass is constant, but it is easy to take into consideration variability of the mass when necessary. H. N. A.

3944. Velocity of Propagation of Gravitational Attraction. J. Chazy. *Comptes Rendus,* 190. *pp.* 1273–1275, *June* 2, 1930.

Provided gravitational attraction is propagated with finite velocity, the rotation of the sun should affect planetary motions; the earth's rotation should affect lunar motion. The magnitude of the anticipated effect is discussed. The suggested experiment of Kogbetliantz [see Abstract 2276 (1928)] relating to the laboratory determination of this effect would, if a positive effect be obtained, contradict both Newtonian theory and the theory of relativity. [See following Abstract.] J. S. G. T.

3945. Velocity of Propagation of Gravitation. E. Kogbetliantz. *Comptes Rendus,* 191. *pp.* 30–31, *July* 7, 1930.

In a previous paper [see Abstract 2276 (1928)] the author has discussed an experiment, involving a determination of the effect produced upon two masses suspended by a torsion balance, due to the rotation of a cylindrical mass, for the determination of the velocity of propagation of gravitational force. Best experimental conditions are here discussed. [See also preceding Abstract.] J. S. G. T.

3946. External Potential and Superficial Gravity of a Planet. B. Gulotta. *Accad. Lincei, Atti,* 11. *pp.* 1093–1095, *June* 15, 1930.

In this mathematical paper a rigorous development is given in series of spherical functions of the external potential and of the superficial gravity of a planet which is a spheroid not of rotation. It is the extension to a surface not of rotation of the method given by Mineo. J. J. S.

3947. Gravitation and Energy at Zero. G. Maneff. *Comptes Rendus,* 190. *pp.* 1374–1377, *June* 16, 1930.

In a previous paper [see Abstract 1572 (1925)] the author has shown that the distribution of mass in a static gravitational field is given by the formula $m = m_0 e^{\kappa M/c^2 r}$. Considering the energy relations involved when movement takes place, including Nernst's "energy at zero," the author concludes that the total mass of a planet will become $m_{\text{tot}} = m_0(1 + 3\kappa M/c^2 r)$, and the gravitational force $F = \dfrac{\kappa M m_0}{r^2}\left(1 + \dfrac{3\kappa M}{c^2 r}\right)$. The displacement of the perihelion can be derived from this, and the result obtained in the case of Mercury is the same as that obtained by the theory of relativity. H. N. A.

3948. Newton's Law of Gravitation in an Infinite Euclidean Space. J. Dougall. *Phil. Mag.* 10. *pp.* 81–100, *July,* 1930.

The procedure which seems most natural for supplementing Newton's law of the inverse square before it can be applied to a distribution of matter in infinite space, appears to be a modification of Poisson's equation which, though unimportant for ordinary application, is of considerable cosmological significance, since it permits the possibility of a gravitational potential and intensity everywhere finite, even when the distribution of matter is of broadly uniform character throughout all space. A similar modification is suggested for the equations of general relativity. The main effect of the modification is that the world is macroscopically Galilean, so that space would be Euclidean instead of having a small constant positive curvature as in Einstein's theory. J. S. G. T.

3949. Potential and Attraction of Rectangular Bodies. C. E. Wright. *Phil. Mag.* 10. *pp.* 110–127, *July,* 1930.

It is shown that the case of similarly oriented rectangular bodies is amenable to straightforward methods, and that numerical results can be obtained without excessive labour. As examples are given the determination of the potential of a uniform rod at any point in space, the mutual potential of two rods, the potential due to a uniform rectangular plate, mutual potential of a rectangle and a rod parallel to one of its edges, potential of a rectangular solid, mutual potential of a rectangle and a rod perpendicular to its plane. Other cases are treated, and the force components are given for the different problems. H. N. A.

3950. Interpretation of the Michelson Experiment. J. le Roux. *Comptes Rendus*, 190. *pp.* 1277–1279, *June* 2, 1930.

The author interprets the Michelson experiment in terms of Hadamard's theory of wave propagation based upon a linear equation between partial derivatives of the second order. It is shown that interference, in the experiment, occurs between " interference " waves and not progressive waves. J. S. G. T.

3951. Symmetry of Time in Physics. G. N. Lewis. *Science*, 71. *pp.* 569–577, *June* 6, 1930.

A general account of the author's theory that only symmetrical time exists in the physical world and that the unidirectional time of consciousness has no counterpart therein. It is shown that the continued increase of entropy of a system has no significance as a means of determining the direction of the " flow " of time, if the statistical view of thermodynamics is adopted. Increase of entropy corresponds merely to a loss of information with regard to a state of a system and is thus a purely subjective concept. Irreversible processes in radiation theory, again, can be interpreted as reversible ones, if light is supposed propagated in quanta, so that they also have no temporal significance. Finally, the theory of the symmetry of time is applied to deduce the principle of detailed balancing in chemistry and the principle of the equality of direct and reverse transition probabilities from one state of a system to another. G. C. McV.

3952. Spherically Symmetrical Field in the Unified Theory. N. Rosen and M. S. Vallarta. *Phys. Rev.* 36. *pp.* 110–120, *July* 1, 1930.

A systematic investigation of the spherically symmetrical statical field in Einstein's unified theory is developed for two cases, with and without time-symmetry respectively. A time-symmetrical field is one in which the Riemann interval is not altered by changing $+dt$ into $-dt$. In the present theory the Newtonian and Coulomb fields can be separated only asymptotically. In the immediate vicinity of a charged mass particle they are inextricably bound together. The solution for the case of time-symmetry shows that the electrostatic field vanishes, but the component g_{44} of the metric has approximately the Schwarzschild value, while the others have the Euclidean values. Because of the absence of a law of motion no observable predictions relating to the path of an exploring particle can be made. It is shown, however, that the theory gives, to a first approximation, the same red shift as the 1916 theory. Further, if the orbit of a planet be assumed to be a Riemannian geodesic then the advance of the perihelion of Mercury is approximately 7″ per century, as in the 1905 theory. [See Abstract 69 (1929).] J. S. G. T.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

3953. Meteorology and Water Supply. H. Lapworth. *Roy. Meteorolog. Soc., J.* 56. *pp.* 271–286, *July,* 1930.

The author traces the journey of the rain from its precipitation to the source of supply and deals with the hydrological and hydro-geological problems involved. Rainfall observations are considered in the values of the " three driest consecutive years " for storage at a reservoir, the driest year, and maximum rainfall intensity, evaporation losses and the effects of temperature and forests, perviousness of the soil and floods. The underground water flow as affected by surface features, major fluctuations at different heights and minor fluctuations due to barometric pressure, temperature and, near the sea, by tides, are examined. Finally, types of springs, wells, and the effect of pumping in different localities, and artesian basins in different parts of the world and their contents are considered. R. S. R.

3954. Microseisms Associated with Disturbed Weather in the Indian Seas. S. K. Banerji. *Roy. Soc., Phil. Trans.* 229. *pp.* 287–328, *July* 5, 1930.

A Milne-Shaw seismograph at Colaba was adjusted to record earth vibrations when the weather was sufficiently disturbed to give a wind exceeding 20 m.p.h. Three types of microseisms were observed: (1) steady vibrations, period 4–10 secs. due to the S.W. monsoon beginning as the monsoon reached the S.E. Arabian Sea and increasing in amplitude as it moves north; (2) irregular variations in amplitude, period 4–6 secs., due to storms in the Arabian Sea or Bay of Bengal, and (3) vibration due to local disturbances such as land and sea breezes, period 10–30 secs. A mathematical expression is obtained for sea waves, in case (1) of observed height with winds of different speeds. These waves are produced at the sea bottom and the vibrations act over land like Rayleigh waves with period and amplitude agreeing well with theory. The ratio of the amplitudes of horizontal to vertical component of the microseism has a maximum value of 3 and a minimum of 0·7, the value depending on distance from the disturbed region. In case (2) the irregular variations are due to wind-speed differences over the storm area; they show as soon as the storm forms and increase as it develops, and the amplitude is a function of the distance away and intensity of the storm. In 5 years all storms in the Arabian Sea and the Bay of Biscay showed these vibrations. In case (3) the vibrations are due to waves on the shallow sea near the coast, the sea breeze being more important. R. S. R.

3955. Bibliography of Seismology. E. A. Hodgson. *Dominion Observat. Ottawa, Publ.* 10. *No.* 5. *pp.* 67–86, *Jan., Feb., March, and* 10. *No.* 6. *pp.* 89–100, *April, May, June,* 1930.

3956. Piezoelectric Accelerometer and its Application to the Measurement of the Velocity of Elastic Waves Produced by Artificial Disturbances. Y. Katô and S. Nakamura. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 272–274, *July,* 1930. *In English.*

The piezoelectric oscillator is placed between a horizontal pendulum and its supports, and is connected to a bridge amplifier in the anode circuit of which is an Edelman electrometer. Earth tremors affect the oscillator, and are recorded on a photographic film by the electrometer spot. The velocity of propagation of the tremors was found directly, electric records of the time of origin being compared with the records of the piezoelectric oscillator, hence the time factor being found. G. E. B.

3957. Determination of the Orbit of the Trans-Neptunian Planet by Three Observations. A. Véronnet. *Comptes Rendus,* 191. *pp.* 24–26, *July* 7, 1930.

The author shows that by a special form of vectorial calculus the orbit, as given by Esclangon's method [see Abstract 3370 (1930)] can be obtained. He states that the discovery of this planet confirms calculations and statements made by him in the publication *Constitution et Évolution de l'Univers.* R. S. R.

3958. Connection of Mass with Luminosity for Stars. J. Larmor. *Observatory,* 53. *pp.* 167–177, *June,* 1930.

In the calculation of the mass-luminosity relation from the equations of equilibrium for the radiation and hydrostatic pressures, it is suggested that the only necessary boundary condition is that the density should tend to zero at the surface. The radiation pressure at the surface need not tend to zero, but to the finite value corresponding to the surface temperature. Some general remarks on the correlation of partial theories are appended. G. C. McV.

3959. Orbit of RS Canum Venaticorum. A. H. Joy. *Mt. Wilson Observat. Contrib. No.* 40. *Astrophys. J.* 72. *pp.* 41–45, *July,* 1930.

The orbit of RS Canum Venaticorum is based on 35 spectrograms obtained with the 60- and 100-inch reflectors. Schneller's elements (Min. = J.D. 2423579·344 H.G.M.T. + $4^{d}\cdot797944E$) were used in the computation of phases. The lines of both components are visible in the spectrograms. A table is given of the observations, velocities, weights and residuals. The spectrum of the primary star is F4, that of the secondary is dG8. The secondary is best observed at total eclipse, which lasts 3·7 hours. The spectroscopic absolute magnitudes are 3·5 and 4·5, respectively, and the parallax is $0''\cdot010$. The elements of the orbit are: $e = 0\cdot0$ (assumed); $K_1 = 91\cdot6$ km./sec.; $K_2 = 99\cdot0$ km./sec.; $\gamma = -8\cdot9$ km./sec.; $a_1 \sin i = 6{,}040{,}000$ km.; $a_2 \sin i = 6{,}530{,}000$ km.; $m_1 \sin^3 i = 1\cdot79$; $m_2 \sin^3 i = 1\cdot66$. The absolute dimensions were determined with the aid of B. W. Sitterly's photometric solution for the inclination and radii of the stars. The fainter star is exceptionally large and massive for its absolute magnitude and spectral type. AUTHOR.

3960. Radial Velocities of the Cepheid Variables W Geminorum, U Aquilæ, and DT Cygni. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 404. *Astrophys. J.* 72. *pp.* 46–58, *July,* 1930.

Curves of radial velocity for W Geminorum, U Aquilæ, and DT Cygni have been derived from Mount Wilson spectrograms and a series for U Aquilæ obtained at the Lick Observatory. The semi-amplitudes of variation in velocity are 16·7, 20·8 and 7·5 km./sec., respectively. The velocities of the systems are − 0·7 − 7·0, and − 0·5 km./sec. The velocity-curves of U Aquilæ and DT Cygni are mirror images of the light-curves, *i.e.*, maximum velocity coincides with minimum light and minimum velocity with maximum light. For W Geminorum the interval between maximum and minimum velocity is nearly a day less than the mean interval between minimum and maximum light. Since the period derived from the radial velocities shows that maximum velocity coincides in the mean with minimum light, it follows that with this period minimum velocity precedes maximum light by nearly a day. Superposed minor fluctuations are present in the light-curves of W Geminorum and U Aquilæ. Evidence for kindred fluctuations in the velocity-curves is slight for the former and lacking for the latter. AUTHOR.

3961. Systematic and Accidental Errors of Modern Trigonometrical Parallaxes. W. J. Luyten. *Nat. Acad. Sci., Proc.* 16. *pp.* 464–473, *July,* 1930

Some years ago the parallax determinations of the Allegheny and McCormick Observatories were discussed, and a Lexian ratio of 1·24 was derived for the conversion of the published probable errors to the actual errors. The same analysis is now applied to all photographic trigonometrical parallaxes available up to September, 1929. The systematic differences between the series from different observatories are very small. The Lexian ratios are now found to be 1·11 for the McCormick Observatory, 1·18 for Allegheny, 1·23 for Sproul, 1·26 for Greenwich, 1·30 for Yerkes. Mount Wilson has the somewhat larger ratio of 1·97, probably because a reflector was used. The Johannesburg station of Yale has 2·00, and it is possible that a systematic difference may exist for parallaxes determined south of the equator. When a larger number from Johannesburg becomes available, and especially when independent data can be obtained from the new Cape parallaxes, the matter can be investigated further. The surprisingly small Lexian ratios prove the excellence of the methods employed, and the extreme care given to the measures and reductions. M. A. E.

3962. Galactic Rotation. J. K. Fotheringham. *Roy. Astron. Soc., M.N.* 90. *pp.* 749–754, *June,* 1930.

The author urges that galactic rotation is not necessarily in the Milky Way plane [see Abstracts 2114 and 2786 (1930)] and finds a clear correlation between mean rotation rate and luni-solar precession derived from various determinations, but no support for including the factor cos b (b = galactic latitude) in rotational rate. He suggests a progress of a different kind [see Abstracts 96 and 2780 (1930)]. If the differential rotation represents excess of solar angular over mean stellar galactic rotation, these two terms should vary inversely with different stellar selections, whereas they vary directly, and the size of both terms are affected rather by stellar spectral type than by distance or by position in the sky. The author collects seventeen determinations from proper motions so as to ascertain how apparent rotation and apparent precession are components of a non-galactic rotation plane, and from these he has made two analyses, finding for the correction to Newcomb's centennial precession on the ecliptic, for Newcomb's combined correction to the centennial motion of the equinox and precession on the equator, respectively, the values, $+ 0''\cdot 98 \pm 0''\cdot 11$ and $+ 1''\cdot 28 \pm 0''\cdot 10$, which are in close agreement with his own 1926 results [see Abstract 2303 (1926)], and Oort's results in 1927. He deduces the position for the plane of rotation as inclined about51° to the Milky Way plane. [See also Abstract 2485 (1930).] A. S. D. M.

LIGHT.

3963. Wave-Lengths of Complementary Hues. I. H. Godlove. *J.O.S.A.* 20. *pp.* 411–418, *July*, 1930.

The equations of Priest and Grunberg for complementary colours are in the form of parabolæ, and the results for individual observers approximate to this. By suitable change of variables the data can be plotted as straight lines and thus give a simpler graphical picture of the variations of colour vision for individual observers. For fifteen observers, agreement results for fourteen, while the other has an abnormal white point. For any other observer, if normal, the complete range of complementary wave-length pairs may be obtained from observation of two pairs. The method gives a simple accurate way of finding the constants of the equations of the hyperbolæ for individuals and a simple way of finding an average.

R. S. R.

3964. Validity of Beer's Law in Violet Solutions of Iodine. J. Gróh and S. Papp. *Zeits. f. phys. Chem.* 149. *Abt. A.* 1–2. *pp.* 153–160, *July*, 1930.

Determinations of the molecular extinction coefficient for dilute and concentrated violet solutions of iodine in carbon tetrachloride, carbon disulphide and hexane show that Beer's law is valid for visible light (450 to 640 mμ), but not for violet and ultra-violet light (250 to 300 mμ), in which the extinction coefficients are greater in concentrated than in dilute solutions. These deviations appear to be due to the presence of molecules of the polymer I_6.

A. J. M.

3965. Ultra-Violet Absorption of Solutions of Tartaric Acid. G. Bruhat and J. Terrien. *Comptes Rendus*, 191. *pp.* 37–39, *July* 7, 1930.

Previous measurements [see Abstract 1408 (1930)] have been extended to determine whether the variations of absorption correspond with those of a normal substance. It was found difficult to obtain consistent results when using glass tubes, although matters improved with the use of fused quartz. Beer's law is found to hold for concentrations from 0·16 to 3·3 gramme molecule per litre, and no indication of two forms with differing absorption.

F. S.

3966. Comparative Absorption of Aqueous Solutions of Active and Racemic Tartaric Acids. G. Bruhat and J. Terrien. *Comptes Rendus*, 191. *pp.* 125–127, *July* 21, 1930. *J. de Physique et le Radium*, 1 *pp.* 373–376, *Nov.*, 1930.

The absorption for ultra-violet light ($\lambda = 2653$–2400) of *d*-, *l*-, and *r*-tartaric acids has been determined. Freshly made, usually 15 %, solutions were used, that of the *r*-acid being prepared by mixing solutions of the two active acids, thereby avoiding possibility of change in absorption through long contact with glass. The absorption of the *l*-acid in general exceeded that of the *d*-acid, but to a very varying extent; that of the *r*-acid deviates from the arithmetic mean of the absorptions of the two active acids by amounts varying individually from − 9 to + 10 %, but the average of all results shows practically identical absorption. It is concluded that no molecules of the racemic acid exist in solution. [See Abstracts 1803 and 1822 (1930).]

C. A. S.

3967. Ultra-Violet Transmission Band of Metallic Silver, as Affected by Temperature. (Lord) Rayleigh. *Roy. Soc., Proc.* 128. *pp.* 131–133, *July* 1, 1930.

An examination of the effect of temperature on the position and breadth of the transmission band. The experimental methods are briefly described, and it was found that, though no striking effect appeared within the temperature range (− 180° C. to + 254° C.), a rise of temperature caused a definite shift towards the red, but the breadth of the transmission band was not conspicuously affected. The results of the experiments are tabulated and photographically illustrated. J. G. H. B.

3968. Absorption of Ultra-Violet Light by Alkyl Iodides. G. Emschwiller. *Comptes Rendus,* 191. *pp.* 208–210, *July* 28, 1930.

A systematic investigation is now described of the absorption of ultraviolet light by alkyl iodides in liquid form without any diluent at various temperatures and in the gaseous state. A photographic method was used, the products employed being the methyl, ethyl, propyl, butyl and isobutyl primary iodides, the secondary isopropyl and butyl iodides, tertiary butyl iodide, methylene iodide and iodobenzene. The absorption limits proposed by Iredale and Wallace [see Abstract 2045 (1930)] are not confirmed. The primary alkyl iodides are found to behave similarly, but the secondary products absorb more and the tertiary still more than the primary. H. H. Ho.

3969. Experimental and Theoretical Determination of the Refractive Indices of Some Organic Vapours. E. Berl and L. Ranis. *Zeits. f. Elektrochem.* 36. *pp.* 453–454, *July,* 1930.

The refractive indices of vapour : air mixtures of known composition are measured by means of a Haber-Löwe gas interferometer for six organic compounds. The refractive index of the vapour is then obtained from a formula previously deduced for the instrument by the authors. The values obtained from mixtures of various concentrations do not agree too well in the case of liquids of higher boiling point. The refractive indices of the vapours are also calculated directly from those of the liquids by means of the Lorenz-Lorentz formula, and a fair agreement with mean experimental values is obtained. The Lorenz-Lorentz formula is tested against liquids and vapours for which the refractive indices are already known. C. B. A

3970. Dispersion of Some Organic Liquids in the Ultra-Violet. P. Guillery. *Phys. Zeits.* 31. *pp.* 700–710, *July* 15, 1930.

A total reflection method for accurate measurement of refractive indices in the ultra-violet is described. The refractive indices of ethyl alcohol, glycerine and acetone are measured at various temperatures for several wave-lengths in the visible and ultra-violet down to 2650 Å. From these values the constants for a Ketteler dispersion formula are found. The specific refractions satisfy the Lorenz-Lorentz constancy rule very accurately, particularly for glycerine. It is shown that for ethyl alcohol the contribution of the pure temperature effect to the temperature refraction coefficient is negligibly small compared with that due to change of density. C. B. A.

3971. Measurement of Circular Dichroism in the Ultra-Violet. W. Kuhn and E. Braun. *Zeits. f. phys. Chem.* 8. *Abt. B.* 5–6. *pp.* 445–454, *July,* 1930.

A half-shade method with apparatus is described which permits the measurement of circular dichroism in the ultra-violet up to 1900 Å., and in which any rotation of the plane of polarisation produced by the substance is without influence on the result. The apparatus can also be employed for the detection and measurement of feeble double refraction in the visible and ultra-violet. Data obtained for the ethyl ester of α-azidopropionic acid are described and discussed. H. H. Ho.

3972. Analysis of Colours Observed in Photoelastic Experiments. R. V. Baud and W. D. Wright. *J.O.S.A.* 20. *pp.* 381–395, *July*, 1930.

In this paper an account of the production of the colour fringes in photoelastic experiments is given in detail. In Part I the equation governing the reduction in energy transmission for given wave-lengths and retardations is developed. In Part II some influences are discussed which modify the final light distribution, but which, either owing to the present lack of experimental data or for some other reason, have been neglected in the calculations. In Part III a detailed colour analysis is made of the fringes produced in models with stresses giving retardations up to 2μ. AUTHORS.

3973. Variation with Temperature of the Specific Magnetic Rotatory Powers of Cerium Nitrate and Nickel Chloride. H. Ollivier. *Comptes Rendus*, 191. *pp.* 130–132, *July* 21, 1930.

The magnetic rotation of a solution of cerium nitrate containing equal masses of anhydrous salt and water (d^0 1·6337, d^{61} 1·5822) has been determined at various temperatures from 0° to 70°. If the additive law [see Abstract 2111 (1928)] is used to calculate the magnetic rotation per gramme of anhydrous salt the relation $\gamma(t + 292\cdot 1) = -17090$, t being expressed in °C., is deduced, which is analogous to the Weiss law for susceptibility. The temperature corresponding to the Curie point is thus $-19\cdot 1°$ Abs. In the case of nickel chloride γ decreases slightly with fall of temperature in aqueous solution, but increases in methyl alcohol, thus not following an analogue to the Curie law. C. A. S.

3974. Optical Rotatory Power. *Faraday Soc., Trans.* 26. *pp.* 266–312, *June*, and *pp.* 313–460, *July*, 1930.

A treatise on the subject comprising twenty-two papers and discussions by various contributors, arranged under four main headings, preceded by an introductory paper, " Some Modern Aspects of the Problem of Optical Rotatory Power," by **T. M. Lowry,** and terminated by a "Summary" by the same author.

Part I.—The Physical Basis of Optical Rotatory Power—" Wave Mechanics of Optical Rotation and of Optically Active Molecules," by **G. Temple;** " Molecular Theory and Calculation of Natural Rotatory Power," by **R. de Mallemann;** " Physical Significance of Optical Rotatory Power," by **W. Kuhn;** " Some Remarks on General Physical Aspects of Natural Optical Activity," by **P. P. Ewald.** *Discussion* by **G. Temple, T. M. Lowry, C. P. Snow, P. P. Ewald, E. Darmois, R. Lucas** and **W. Kuhn.** " Principle of Free Rotation in Optically Active Molecules," by **K. L. Wolf;** " Influence of Polar Substituents on Optical Rotatory Power of Organic Compounds," by **H. G. Rule;** " Optical Rotatory Power and Chemical Constitution," by **M. Betti;** " Dependence of Optical Rotatory Power on Chemical Constitution," by **B. K. Singh** and **B. Bhaduri.** *Discussion* by **K. L. Wolf, R. Lucas, W. Kuhn, T. M.**

Lowry, P. C. Austin, E. Darmois, E. Bretscher, M. Betti, H. G. Rule and **Belaiew.**

Part II.—Apparatus and Methods—"Methods for Measuring Rotatory Power in the Ultra-Violet Region of the Spectrum," by **R. Descamps;** "Note on the Calculation of Dispersion Equation," by **T. M. Lowry** and **G. Owen.** *Discussion* by **E. Darmois.**

Part III.—Rotatory Power of Solutions—"Existence of Racemic Compounds in Solution and Application of Circular Dichroïsm to Synthesis of Active Compounds," by **A. Cotton;** "Salt Effect and Rotatory Power" by **E. Darmois;** "Polarimetry as a Means of Investigating Solutions of Strong Electrolytes," by **(Mrs.) J. Liquier-Milward.** *Discussion* by **C. Drucker, E. Darmois** and **W. Kuhn.** "Absorption and Rotatory Dispersion of Solutions of Tartaric Acid," by **G. Bruhat;** "Rotatory Dispersion of Tartaric Acid and its Derivatives," by **P. C. Austin;** "Origin of Variations in Rotatory Power of a Compound," by **R. Lucas;** "Effect of Concentration on Values of Dispersion and Rotation Constants for Solutions of Camphor in Ethyl Alcohol," by **G. Owen.** *Discussion* by **G. Bruhat, R. Lucas, T. M. Lowry, P. C. Austin** and **E. Darmois.**

Part IV.—The Chemical Aspects of Optical Rotatory Power—"Molecular Dissymmetry," by **W. H. Mills;** "Relations Between the Rotatory Powers of Members of Homologous Series," by **J. Kenyon;** "Optical Superposition," by **J. Read;** "Some Recent Developments in the Study of the Walden Inversion," by **J. Kenyon** and **H. Phillips.** *Discussion* by **E. Bretscher, K. L. Wolf, W. Kuhn** and **H. G. Rule.**

3975. Measurement and Interpretation of the Rotation-Dispersion of Simple Substances. W. Kuhn and E. Braun. *Zeits. f. phys. Chem.* 8. *Abt. B.* 4. *pp.* 281–313, *June*, 1930.

Measurements are now recorded for the absorption and rotation-dispersion of α-azidopropionic ethyl ester and its dimethylamide and of α-bromopropionic ester and its dimethylamide, using the apparatus previously described [see Abstract 119 (1930) and preceding Abstract], by means of which the rotation of the plane of polarisation of ultra-violet light up to wave-lengths of about 2000 Å. can be determined. The data enable a discrimination to be made of some of the factors which make up the total rotation, although they only represent the 10^{-4} to 10^{-5} part of the optical absorption, while being 0·2 to 2-fold of the total rotation in the yellow. It appears that the anisotropy of a weak band is due to a coupling with strong bands of other substituents in the Schumann region, and that these strong bands are little disturbed by small changes of their carriers, while the weak bands are much more sensitive to such changes. Examples of the magnitudes of the coupling forces are given, and it is shown that they are almost completely independent of the intensities of the coupling bands. H. H. Ho.

3976. Rotatory Dispersion in Amorphous Systems. G. Kortüm. *Phys. Zeits.* 31. *pp.* 641–670, *July* 15, 1930.

A survey of recent theory and experimental methods, including a bibliography to date.

3977. Temperature Variation of Kerr Constant in Gases, with Data for Methyl and Ethyl Alcohol. H. A. Stuart. *Phys. Zeits.* 31. *pp.* 616–617, *July* 1, 1930.

The Kerr constants for CS_2, C_2H_5Cl, CH_3Br are given for temperatures from 290 to 370° K. The variation is in agreement with that predicted by the Langevin-Born theory. For methyl and ethyl alcohols, the constant is less than 1/30 of that found for the other substances mentioned. Suggestions as to the structure of these alcohol molecules are advanced to account for this small effect. J. H. A.

3978. Existence of a Latent Period in the Kerr Effect. I. Ranzi. *N. Cimento*, 7. *pp.* 270–282, *July*, 1930.

Beams and Allison have claimed that the Kerr effect in chloroform takes longer to develop than that in carbon disulphide, by about 3×10^{-9} sec. It is shown that oscillations occurring in their apparatus might account for the results found, without postulating this delay. By a new method, it is shown experimentally in the present paper that if there is any latent period, it is less than 3×10^{-10} sec. for chloroform, carbon disulphide and nitrobenzene. A theoretical section shows that the delay to be anticipated is of the order 10^{-11} sec. for all three substances.
J. H. A.

3979. Scattering of Light by Dielectrics of Small Particle Size. G. F. A. Stutz. *Frank. Inst., J.* 210. *pp.* 67–85, *July*, 1930.

The diffusion of light by a cloud or suspension of small particles may be due to Rayleigh scattering, to reflection and refraction, or to a combination of these. The paper contains the results of a study of the diffusion of light by zinc oxide over a range of particle sizes. Experiments on turbidity, and an apparatus for determining the angular distribution and the polarisation of the light scattered by a suspension, are described. The turbidity maximum for zinc oxide dispersed in water is determined for three wave-lengths. It occurs at smaller particle sizes for shorter wave-lengths, with a value $0{\cdot}25\,\mu$ at 5500 Å. The particle size of maximum turbidity is found to be proportional to the wave-length in the range 4800 Å. to 6300 Å. The total intensity of the scattered light as observed does not have the same distribution as that calculated by Blumer, but the observed depolarisation follows the general trend of the theoretical values. C. B. A.

3980. High-Frequency Interference Fringes. F. Villani. *N. Cimento*, 7. *pp.* 248–253, *June*, 1930.

Confirms the formula given by Ronchi for interference fringes up to 100 or 200 lines per cm., giving photographic examples. For higher frequencies he gives a more approximate calculation, which he verifies up to 800 lines per cm. E. E. F. d'A.

3981. Quantistic Electrodynamics. G. Racah. *Accad. Luicei, Atti*, 11. *pp.* 1100–1104, *June* 15, 1930.

A mathematical discussion of Dirac's quantistic electrodynamics from which the author concludes that in all the phenomena of transmission and interference of light Dirac's theory must give the same results as the classical method. [See also Abstract 3389 (1930).] J. J. S.

3982. Zonal Aberration. F. Scandone. *N. Cimento*, 7. *pp.* 289–304, *July*, 1930.

Gives a theoretical treatment of the form assumed by the shadow pattern of a square network when this is placed in the path of a wave affected by spherical aberration. If the formulæ be applied to a case of simple spherical aberration or of first order zonal aberration, the pattern obtained gives a measure of the aberration present. J. W. T. W.

3983. Light Filter for the Isolation of Narrow Spectral Regions. L. A. Jones. *Phot. J.* 70. *pp.* 337–346, *July*, 1930. *Kodak Research Lab., Comm. No.* 335.

Describes the results obtained when certain Wratten filters, distilled water, aqueous copper sulphate solution, aqueous nickel sulphate solution, and Corning glasses are used either separately or in combination. The aim was to produce filters which would remain constant, transmit only comparatively narrow spectral regions and still have a comparatively high transmission factor. After describing the absorption characteristics of the materials used, those of the filters developed are given together with their transmission curves. Finally, a summary of the components of the various filters, together with their characteristics including wave-length limits, maximum wave-length and maximum transmission, is given.

R. C. F.

3984. Infra-Red Filters of Controllable Transmission. A. H. Pfund. *Phys. Rev.* 36. *pp.* 71–76, *July* 1, 1930.

When using an echelette grating for work in the infra-red it is necessary to eliminate overlapping, higher orders. Since no adequate series of true filters covering the entire infra-red is known, a new type of filter has been developed. Essentially, this type of filter consists of a powder spread uniformly over a surface of polished speculum. Short wave-length radiations are reflected diffusely, while long wave-length radiations are largely transmitted since the Rayleigh scattering for long waves is feeble. The region of transition from opacity to transparency is controlled by choosing powders of proper particle-size and by depositing these in layers of appropriate thickness. Specific examples, involving the use of particles whose mean diameter covers the range: $0\cdot22\,\mu$ to $2\cdot5\,\mu$, are presented to show how filters for almost any portion of the spectral range: $2\,\mu$ to $7\cdot5\,\mu$ may be largely freed from the effects of superposed, higher orders. Filters for greater wave-lengths may be produced by much the same methods.

AUTHOR.

3985. Orthogonal Trajectories of the Generators of a Ruled Surface. M. Dufour. *Comptes Rendus*, 191. *pp.* 39–42, *July* 7, 1930.

A simple mathematical deduction of radius of curvature and geodetic torsion of lines on a wave surface, these quantities appearing in Sturm's three equations which are fundamental in the theory of astigmatism. F. S.

3986. Field of View in the Oclinometer. L. E. Dodd. *J.O.S.A.* 20. *pp.* 367–380, *July*, 1930.

The paper presents two phases of the subject. (I) Schematic description of an apparently new type of optical instrument, designed by Liggett and Dodd, which permits conditions within wide limits for accommodation of the eyes independent of convergence, and also the measurement of muscular imbalance (strabismus) and range of fusion. It uses plane mirrors rather than refracting prisms, thus eliminating distortion, chromatic aberration and astigmatism in the images. The optical system is essentially different from that of the short-base range finder and of the Helmholtz stereoscope, in that (*a*) rays enter the eyes from the *outer* rather than the inner mirrors, and (*b*) the outer mirrors are variable in position through large angles. (II) Derivation of geometrical expressions for (1) magnitude of "field of view" (that is, angular range of visibility of secondary image of stationary point-object), (2) direction of field of view and (3) boundaries of useful areas of mirrors—applicable to a pair of independently variable plane mirrors with parallel axes in the respective planes, as adapted in an instrument of this kind (one pair of mirrors to each eye). The designing entailed the fulfilling of several requirements having somewhat narrow limits and culminated in finding a suitable combination of some half-dozen variable quantities. AUTHOR.

3987. Two High-Speed Camera Objectives for Astronomical Spectrographs. W. B. Rayton. *Astrophys. J.* 72. pp. 59–61, *July*, 1930.

Two new objectives of large relative aperture are described: (*a*) a magnified and somewhat modified copy of a 16-mm. microscope objective having a focal length of 5 in. and relative aperture f/2·4; (*b*) a modified copy of a 4-mm. microscope objective of numerical aperture 0·85 having an equivalent focus of 32 mm. and relative aperture f/0·59. AUTHOR.

3988. Source of Light for Resonance Lines. P. Kunze. *Ann. d. Physik*, 5. 6. *pp.* 793–796, *July* 7, 1930.

The lamp uses mercury and a mixture of neon and helium, in order to give the mercury line 2537. It is claimed that it is much more constant than one using mercury only, although somewhat less intense. J. H. A.

3989. Measurement of Low Brightnesses. J. Dufay and [Mlle.] R. Schwégler. *Rev. d'Optique*, 9. *pp.* 263–278, *June–July*, 1930.

This paper deals with the measurement of surface brightness between the limits 10^{-6} and 5×10^{-10} candles per sq. cm. (stilbs). Both the brightness and angular size of the photometric field were varied. The light was "white," *i.e.*, colour of a tungsten filament vacuum lamp. The special type of photometer used is illustrated in the paper. The field was of the "equality of brightness" type with diametral dividing line. A statistical study of the distribution of the errors of reading was made and it was found that the distribution was Gaussian, so that the root mean square of the errors could be used as a proper measure of precision. If the reciprocal of this quantity be taken as the precision and represented by p, it is found that the value of p can be well represented by the empirical formula $16 \cdot 4\ (10 + \log_{10} B) - 1/\alpha$, where B is the brightness in stilbs and α the apparent diameter of the field in radians. The least perceptible brightness was found to change from $4 \cdot 8 \times 10^{-10}$ stilbs when $\alpha = 0 \cdot 05$ to $1 \cdot 1 \times 10^{-10}$ stilbs when $\alpha = 0 \cdot 25$. It is concluded that such measurements as those of the brightness of the night sky seen through various coloured filters are necessarily subject to very large errors. J. W. T. W.

3990. Comparison of Resolving Power and Sensitivity of Photographic Plates with Varying Development. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research*, 5. *pp.* 1–11, *July*, 1930.

Special developers recommended for reducing the graininess of photographic images are all based on increasing the solvent action of the solution on silver bromide, and decreasing the reduction potential. Five of these formulæ were compared with ordinary pyrogallol and metol-hydroquinone by testing sensitivity and resolving power of three emulsions, each developed with each of the developers. These results were supplemented by practical spectrographic tests, and experiments with two other developers. Little useful improvement over the standard developers was obtained in any case, as increased resolution was, in general, accompanied by decreased sensitivity. These results do not apply to the pictorial use of special development to reduce graininess. AUTHORS.

3991. Unreliability of Photographic Emulsions on Glass for Recording Distances and a Method of Minimising this Defect. D. Cooksey and C. D. Cooksey. *Phys. Rev.* 36. *pp.* 80–84, *July* 1, 1930.

Superficial motions of double-coated emulsions were investigated by Schlesinger's ink-dot method. Also the positions of developed images with respect to corresponding latent images were studied for singly coated plates. Apparently there are stresses in undeveloped gelatin emulsions that can be relieved before plates are used for photographic pusposes by soaking them in water followed by dehydration in alcohol, thus greatly enhancing their reliability for recording distances. This process we have termed normalising. The maximum observed change in a distance between images in their latent and developed states on a singly coated plate was 9μ without normalising and $2{\cdot}2\mu$ with normalising. The average change was likewise reduced to about one quarter. The advantage of normalising is emphasised by the results reported in another paper. [See Abstract 4039 (1930).] AUTHORS.

3992. Desensitisation and Other Dye Reactions. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 28. *pp.* 73–85, *July*, 1930.

It has already been shown that diapositive or low sensitivity plates when diffusely illuminated prior to desensitisation and then illuminated by light passing through a yellow filter, become very much weaker, whilst negative or high sensitivity plates so treated show only fog and no bleaching action. If a red filter be used the negative plates indicate a greater bleaching than do the diapositive plates. Further results illustrating this latter phenomenon with a red filter using pinakryptol green, phenosafranine and pinakryptol yellow desensitisers are given. The fact that only fogging occurs with negative plates when illuminated by light through a yellow filter is also indicated, and this holds for both pinakryptol green and yellow dyes. A comparison is also given of the effect of fuchsin compared with pinakryptol yellow, considering especially "duplicate negatives." The effect of a further direct illumination after the red illumination of a plate treated with pinakryptol green is to increase the density somewhat when compared with a plate not red-illuminated but directly opposed. An attempt to destroy the desensitising action of the dyes by means of a sulphite and a bisulphite indicates only partial restoration of the sensitivity. No definite conclusions could be drawn from the action of a sensitiser on a desensitised plate, but prolonged washing apparently almost completely restored the plate to its normal sensitivity. Finally, the action of desensitisers on panchromatic plates is discussed. R. C. F.

3993. Fog-Delaying and Desensitising Actions. S. E. Sheppard. *Zeits. f. wiss. Phot.* 28. *pp.* 85–91, *July*, 1930.

Develops a definite chemical cycle of operations for the nucleus inactivation by means of thioanilide. This cycle of operations is also shown to be applicable to the photographic behaviour of imidazole and dye desensitisers. The basis for the cycle developed lies in the great reaction capacity of the silver halide in the boundary layer between the nucleus and the silver halide. R. C. F.

3994. Solarisation. H. Arens. *Zeits. f. wiss. Phot.* 28. *pp.* 91–98, *and pp.* 98–110, *July*, 1930.

This paper is divided into two parts, Part I dealing with the influence of brom-ions on solarisation and Part II with the relation between solarisation and preparation of the emulsion. In Part I it is experimentally shown that solarisation is increased by potassium bromide and, for commercial plates or films, by bromine ions if present during illumination of the plate. The solarisation phenomenon disappears completely when the bromine ions are removed by treatment with silver nitrate, which itself is removed by sodium chloride. For peptised silver bromide a similar treatment greatly reduces the solarisation effect. Subsequent treatment with potassium bromide brings back solarisation and also removes the solarisation-delaying action of sodium nitrite. In Part II, by suitably varying the manufacture of the silver bromide and the conditions of its becoming an emulsion, it is found that the peptised silver bodies show less solarisation than the bromide bodies if equal quantities of potassium bromide are present in the emulsions. A larger quantity of potassium bromide present during peptisation produces a raising of the minimum of the solarisation curve, in contradistinction to results previously obtained for similar layers. Further, it is not possible to obtain a definite connection of the different solarisation effects occurring with silver and bromide bodies with the grain size distribution. Finally, silver-equivalent and bromide bodies peptised with ammonia show strong solarisation, which increases with increasing ammonia content. R. C F.

3995. "Halogen Value" of Silver Iodide Emulsions. H. H. Schmidt and F. Pretschner. *Zeits. f. wiss. Phot.* 28. *pp.* 111–117. *July*, 1930.

Discusses the various accurate methods of estimating the "halogen" value of silver iodide emulsions, and shows that all such emulsions examined, prepared with an excess of potassium iodide, indicate only iodine ions in the filtrate after destruction with nitric acid. This is opposite to the behaviour of other silver halides, and occurred with neutral, alkaline and highly crystallised emulsions. The residue is also free from adsorbed silver ions. Emulsions with excess silver nitrate also did not gravimetrically indicate silver ions. The grain size, as well as the type of the emulsion, affected the iodide content of the filtrate, that for the highly crystallised emulsion being the least. The adsorbed iodide quantity is inversely proportional to the grain size. Finally, the authors discuss the importance photographically of the results obtained. [See also Abstract 1012 (1930).] R. C. F.

3996. "Silver and Halogen Values" in Photographic Emulsions. H. H. Schmidt and F. Pretschner. *Zeits. f. wiss. Phot.* 28. *pp.* 118–120, *July*, 1930.

The terms "total silver value" and "halogen value" used by the authors are discussed, explaining what actual values have been given to these two terms in the course of their researches. Their use in the characterising of photographic layers is also suggested. [See also Abstract 1430 (1930).] R. C. F.

3997. Photochemical Action of Pulsating and Complex Light. M. Padoa and N. Vita. *Zeits. f. wiss. Phot.* 28. 5. *pp.* 153–167, *July*, 1930.

Contrary to the first author's previous results [see Abstract 1940

(1926)], Berthoud has described experiments from which he concludes that the actions of various monochromatic lights are perfectly additive. The non-additivity of such effects is, however, confirmed by the results obtained by a number of authors, and it may be assumed that this will be the case at least when there is no simple proportionality between intensity and photochemical action. Berthoud's failure to reproduce the first author's results appears to be due to the intensity of the light and the deficiency in actinic power of the light used. Further experimental results (1) confirm the view that, under certain conditions, the photochemical oxidation of hydriodic acid shows a higher efficiency with filtered light than with white light, (2) prove that Berthoud's law for this oxidation holds for white light, and (3) show that, for each monochromatic light, there exists a different relationship between intensity and efficiency. T. H. P.

3998. Luminescence of Zinc Sulphide Under the Action of α-, β- and γ-Rays. G. S. Gessner. *Phys. Rev.* 36. *pp.* 207–213, *July* 15, 1930.

The luminescence of zinc sulphide under the action of α-, β- and γ-rays was studied with an especially designed brass capsule. The zinc sulphide was exposed to the α-rays or β- and γ-rays, or α, β- and γ-rays from radium or its products, while the luminescent material and the exciting agent were kept separate. In this way the effect of these rays upon the luminescent material was observed, separately and collectively. The experiment was made under practically constant temperature. The luminosity time curves for the three types of capsules were consistent in characteristics. It was found that for a time there was a definite increase in brightness; then the luminescence decreased under the constant action of the rays and rose again to a second maximum. This was followed by gradual decrease with time as long as observations were taken. The decay of luminescence of zinc sulphide, after the removal of the radioactive source, showed that the decay curve is not of the type whose ordinate can be expressed by a single exponential term. AUTHOR.

3999. Phosphorescence of Gelatin and Fluorescein at Low Temperatures. K. Ochiai. *Chem. Soc. Japan, Bull.* 5. *pp.* 203–209, *July*, 1930.

The relations between the time of afterglow and the temperature and the time of excitation have been studied. The time of afterglow suddenly increases at about − 220° K., further cooling having no effect. If the time of excitation is more than 5 sec. the time of afterglow is constant. The effects of adding various reagents to fluorescein shows that substitution is not the cause of its phosphorescence at low temperatures.

J. E.

4000. Mutual Influence of Chromophor Groups on Absorption Bands. R. Lucas. *Comptes Rendus,* 190. *pp.* 1497–1499, *June* 23, 1930.

The theory is continued of the mutual influence of chromophor groups on the ultra-violet absorption. The behaviour of the various chromophor groups as oscillators is discussed, and equations are developed by aid of which the frequencies of the absorption bands and the wave-lengths can be calculated. The displacement of the bands towards the red end of the spectrum is of the same order as those obtained in the case of the saturated monobasic and dibasic acids. F. J. B.

4001. Spectrophotometric Study of the Cupri-Pyridine Ion in Aqueous Solution. Auméras and Tamisier. *Comptes Rendus*, 191. *pp*. 99–100, *July* 16, 1930.

The behaviour of the complex ion formed when pyridine is added to a water solution of copper nitrate was studied. The absorption of light of wave-length $0 \cdot 61\,\mu$ yielded evidence of the formation of a complex cupric pyridine-nitrate, and the equilibrium constant of its stability was determined. F. J. B.

4002. Absorption Spectra of Solutions of Nitrates and of Nitric Acid. A. Hantzsch. *Zeits. f. phys. Chem.* 149. *Abt. A.* 3. *pp*. 161–178, *July*, 1930.

The spectral variations of dilute solutions of potassium nitrate produced by foreign electrolytes are investigated from the chemical standpoint and explained as solvation or desolvation effects as the case may be. It is shown by new extinction measurements on almost absolute ethereal solutions of nitric acid that continuous absorption takes place, whereas selective absorption only appears with solutions of appreciable water content. It is concluded that the spectrum of the almost absolute ethereal nitric acid may be used as the reference (normal) spectrum for the absorption of the monomolar pseudo-acid, O_2NOH, for the derivation of the nitric acid equilibrium. H. H. Ho.

4003. Infra-Red Absorption of Some Organic Liquids under High Resolution. R. B. Barnes. *Phys. Rev.* 36. *pp*. 296–304, *July* 15, 1930.

The study of the C–H vibration bands, which occur in organic liquids between $3 \cdot 0\,\mu$ and $4 \cdot 0\,\mu$, has been continued and extended. A more powerful spectrometer with which wave-lengths can be determined as accurately as $\pm\ 0 \cdot 001\,\mu$, has been developed for this work. Values are given here for water-vapour, benzene and toluene. [See also Abstract 3723 (1930).] AUTHOR.

4004. Effect of High Pressure on Near Infra-Red Absorption Spectrum of Certain Liquids. J. R. Collins. *Phys. Rev.* 36. *pp*. 305–311, *July* 15, 1930.

Certain absorption bands of liquid water, methyl alcohol, amyl alcohol and toluene were studied when the liquids were subjected to high pressures. In the case of the first three liquids, pressures up to 5000 kg./cm.^{2} were used, and pressures up to 8000 kg./cm.^{2} were applied to the toluene. No change was found either in the spectral position or in the intensity of the bands studied. The results are of interest, since a change in the polymerisation of polar liquids is supposed to take place with increase of pressure. The absorption bands are characteristic of the molecules, and hence a change in the position and intensity should accompany the change in polymerisation. As no such change was observed, it is concluded that there is no change in polymerisation in the pressure range studied. The pressure necessary to solidify toluene at 20° C. was found to lie between 8100 kg./cm.^{2} and 8300 kg./cm.^{2}. AUTHOR.

4005. Band Spectrum of Ozone in the Visible and Photographic Infra-Red. O. R. Wulf. *Nat. Acad. Sci., Proc.* 16. *pp*. 507–511, *July*, 1930.

The absorption spectrum of ozone is shown to comprise two sets of bands, one strong and one weak, and each set shows a decided tendency towards regular spacing of its bands. The formula $\nu(\text{cm.}^{-1}) = 16{,}625 + n'(1099 - 20n') - n''(435)$, for the values $n'' = 0$ and 1, gives fairly well the positions of the centres of the bands. The value 2 volts is derived as the work of dissociation from the excited state. The significance of the diffuse character of the bands is discussed. J. S. G. T.

4006. Infra-Red Investigations of Molecular Structure. Part V. The Simplest Kind of Polyatomic Molecule. C. P. Snow. *Roy. Soc., Proc.* 128. *pp.* 294–316, *July* 1, 1930.

An account of experimental work upon the vibration-rotation spectrum of N_2O is given. Analysis of the data leads to the symmetrical straight line NON for the form of the molecule. This form is consistent with the Raman spectrum, the dielectric constant, and one of the two recent determinations of the specific heat of the gas. The constants of the molecule are given, and the vibration bands are arranged into a scheme based upon the three fundamental frequencies. Comparison of the molecules N_2O, CO_2, CS_2, shows that from a structural point of view they are the simplest kind of polyatomic molecule. [See Abstract 2162 (1930).] J. J. S.

4007. Spectra of Doubly and Trebly Ionised Lead. S. Smith. *Phys. Rev.* 36. *pp.* 1–4, *July* 1, 1930.

In the spectrum of PbIII three new singlet terms, *viz.*, $6s7s\,{}^1S_0$, $6s7p\,{}^1P_1$ and $6s7d\,{}^1D_2$ have been found to give rise to seventeen new lines which are here reported. Certain discrepancies between the classification of terms by A. S. Rao and A. L. Narayan and the writer are discussed. [See Abstract 2195 (1930).] In the spectrum of PbIV the previously published classifications of lines by J. A. Carroll [see Abstract 1354 (1926)], A. S. Rao and A. L. Narayan are discussed, and certain anomalies are pointed out. Two schemes different in some respects from those already put forward are suggested. AUTHOR.

4008. Spark Spectrum of Cobalt, CoII. J. H. Findlay. *Phys. Rev.* 36. *pp.* 5–12, *July* 1, 1930.

A further examination of the CoII spectrum, based on the previous work of Meggers [see Abstract 2727 (1928)] has been made. A magnetic analysis shows that Meggers' classification of the terms now called $d^7p\,{}^5F^\circ$, ${}^5D^\circ$ should be interchanged, except for the term ${}^5F_5{}^\circ$. Since Meggers' results were obtained from intensity rules, the author's ${}^5F\,{}^5F^\circ$ and ${}^5F\,{}^5D^\circ$ multiplets show irregular intensities. Their strongest lines in these multiplets are, respectively, ${}^5F_n\,{}^5F^\circ_{n-1}$ and ${}^5F_n\,{}^5D^\circ_n$. The magnetic analysis also shows that Meggers' terms ${}^3D$ should be $d^7s\,{}^5P$ and that his ${}^3P$, ${}^3D^1$, and ${}^3F$ should be partly $d^7p\,{}^5P^\circ$ and ${}^5D^\circ$. In addition, the terms $d^7s\,{}^3F$, $d^7p\,{}^3D^\circ$, ${}^3F^\circ$, ${}^3G^\circ$, ${}^5S^\circ$, ${}^5P^\circ$, ${}^5D^\circ$, and the lowest terms $d^8\,{}^3F$ have been found. The location of the second member of the $d^7s\,{}^5F\,{}^3F$ series gives an I.P. of 16·9 volts from d^7s to d^7 and 17·3 volts from d^8 to d^7, in practically exact agreement with the predictions of H. N. Russell. AUTHOR.

4009. Spectra of Gases Lighted with Strong Electrical Discharges. E. O. Hulburt. *Phys. Rev.* 36. *pp.* 13–15, *July* 1, 1930.

Spectra of condensed discharges through hydrogen at pressures up to several cm. of mercury showed, as usual, the Balmer lines merging into the continuous spectrum. With increasing strength of the discharge the Balmer lines widened, the higher members of the series disappeared and the continuous spectrum became more intense, until with 1 mfd. at 15 kV there were no Balmer lines left at all, only the continuous spectrum and some absorption lines due to aluminium from the electrodes, etc. Helium, oxygen and nitrogen exhibited similar changes, *i.e.*, with increasing intensity of the discharge in helium the lines gave way to a continuous spectrum, and in oxygen and nitrogen the molecular bands gave way to spark lines and these in turn to a continuous spectrum. The continuous spectra from all the gases were alike. The intensity distribution across the continuous spectrum was rather even and hardly that of a black body. In the strong discharges the external characteristics of the atoms were pretty well effaced and the conditions perhaps approached those in the interior of a star. AUTHOR.

4010. Spark Spectra of Silver and Palladium (AgII and PdII) —An Extension. H. A. Blair. *Phys. Rev.* 36. *pp.* 173–186, *July* 15, 1930.

An attempt was made to excite the 4*f* electron spectrum of AgII in the Schüler tube with helium. Failure is discussed assuming the excitation process Ag normal atom + He^+. Some little extension was made to the lower spectrum. The Schüler tube was also used to extend the $4d^8 6s$ and $5d$ configurations of PdII. About forty terms were added. A complete list of lines arising from high levels is given. [See also Abstracts 1595 and 2713 (1928).] AUTHOR.

4011. Continuous Spectrum of the Hydrogen Molecule. D. Chalonge. *Comptes Rendus*, 191. *pp.* 128–130, *July* 21, 1930.

From previous work [see Abstracts 2742 (1929) and 2825 (1930)] the following deductions are drawn: (*a*) At all pressures from 0·03 to 100 mm. mercury the lines of the singlet systems with base level $2p^1\Sigma$ have intensities, which, though varying absolutely according to the means of excitation, are relatively constant. (*b*) As pressure decreases the general intensity of the triplet system $3p^3\Pi$–$2s^3\Sigma$ (α or Fulcher bands) is almost constant down to 0·5 mm., but thereafter diminishes rapidly, at the same time showing variations in the relative intensity of the different bands. The system $4p^3\Pi$–$2s^3\Sigma$ (β bands) shows similar variations. (*c*) The intensity of the continuous spectrum decreases with pressure, becoming very small at 0·03 mm., but the relative decrease for different wave-lengths between 2400 and 4400 Å. varies, becoming less for greater wave-lengths. It is suggested in explanation that at higher pressures excitation being small, the proportion of molecules brought to the $2s^3\Sigma$ level is greatest, this level being (except $2p^1\Sigma$, which only produces bands in the Schumann region) nearest the base level $1s^1\Sigma$. As pressure decreases so does this relative preponderance. The changes noted as regards the continuous spectrum agree with the theory of Winans and Stueckelberg. [See Abstract 1549 (1929).] C. A. S.

4012. Resonance (B–A) Band System of the Hydrogen Molecule. H. H. Hyman. *Phys. Rev.* 36. *pp.* 187–206, *July* 15. 1930,

The first part of the paper describes a vacuum grating spectrograph of 3 m. focal length and the procedure adopted for adjustment. Tables of frequencies of observed bands are given, and some spectra reproduced. In the second part of the paper the bands are analysed and quantum assignments made in 68 cases. The moment of inertia and nuclear separation in the normal state (A level) are found to be $0{\cdot}4673 \times 10^{-40}$ g. cm.^{2} and $0{\cdot}75 \times 10^{-8}$ cm. respectively, and for the first electronic excited state

(B level) $1\cdot4225 \times 10^{-40}$ g. cm.^{2} and $1\cdot308 \times 10^{-8}$ cm. The latter state is concluded to be the lower state of the bands studied by Richardson and Davidson. F. S.

4013. Absorption and Collision Broadening of the Mercury Resonance Line. M. W. Zemansky. *Phys. Rev.* 36. *pp.* 219–238, *July* 15, 1930.

The paper is mainly theoretical. An approximate expression for the frequency distribution of radiation from a resonance lamp is first obtained. Measurements of absorption are then described and found to agree with the observations of other workers, providing the ratio of breadth as deduced above to the Doppler breadth be suitably adjusted. The Lorentz collision breadth is found as a function of the pressure of the gas in a number of cases for which the absorption of mercury vapour is experimentally determined. F. S.

4014. Resonance and Quenching of the Third Principal Series Line of Cæsium. C. Bœckner. *Bureau of Standards, J. of Research,* 5. *pp.* 13–18, *July,* 1930.

A helium discharge is used as a source for the study of the resonance radiation from the third principal series line of cæsium. This is possible, due to the coincidence of a strong helium line with the cæsium line. A number of cæsium arc lines are also observed in the fluorescent radiation; they have their origin in lower levels populated by radiation transitions from the initial level ($4P_{1/2}$). The effect of helium on the fluorescent radiation is studied. It is found that collisions between helium and cæsium atoms in the $4P_{1/2}$ state transfer the latter only to states differing by less than several hundredths of a volt from the initial state. Transfers to states differing by as much as $0\cdot18$ volt are improbable. AUTHOR.

4015. Regularities in the Spectra of Lutecium. W. F. Meggers and B. F. Scribner. *Bureau of Standards, J. of Research,* 5. *pp.* 73–81, *July,* 1930.

Up to the present time no significant regularities have been found in the spectra of any of the rare earth elements, 58 Ce to 71 Lu. A study of the arc and spark spectra of the last of these, lutecium, resulted in a separation of the lines into three distinct classes: (1) Those characterising neutral atoms, constituting the LuI spectrum; (2) those due to singly ionised atoms, the LuII spectrum; and (3) a small number of lines ascribable to doubly ionised atoms, the LuIII spectrum. Regularities have been discovered in each of these spectra. The normal state of neutral Lu atoms is represented by a ^2D spectral term arising from the electron configuration s^2d; its levels are separated by $1993\cdot9$ wave numbers. The normal state of Lu$^+$ atoms is described by a ^1S (*ss*), and metastable terms ^1D, ^3D (*ds*), ^3F (*dd*) have also been established. A ^2S (*s*) term describes the normal state of Lu^{++} atoms. There is no evidence of *f* electrons playing any part in the production of the spectra; it is concluded that the fourteen *f* electrons in Lu form a closed shell of considerable stability. The structures of Lu spectra resemble those of Y more closely than those of La or Sc. AUTHORS.

4016. Properties of the Abnormal Series and Rays in Atomic Spectra. H. Deslandres. *Comptes Rendus,* 191. *pp.* 7–11, *July* 7, 1930.

Concludes the results previously given [see Abstract 3727 (1930)] by amplifying those for lithium and examining the abnormal rays and series of potassium. The importance of the elementary frequency $d_1 = 1062\cdot5$

is indicated for chromium and iron, and it is shown that the displacement of the rays towards the red end of the spectrum caused by pressure is connected with d_1. Rays are considered to be multiples of d_1 when the difference between the true frequency and the estimated frequency is less than $d_1/10$ and the *raies ultimes* of the simple bodies He, Li, C, Na, Ca$^+$, Hg, Sr$^+$ all indicate small differences which lie between 0 and $d_1/10$. [See also following Abstract.] R. C. F.

4017. "Raies Ultimes" of the Alkaline Metals and Earths. H. Deslandres. *Comptes Rendus*, 191. *pp.* 169–173, *July* 28, 1930.

Examines the *raies ultimes* and very strong rays of the alkaline metals and earths, considering more particularly those which occur in the red and infra-red. A table is given of the *raies ultimes* and some very intense rays of the elements occurring in the first two columns of the periodic table. These rays are nearly all multiples of the elementary frequency d_1, strontium being the only element for which the *raies ultimes* fail to agree with this peculiarity. [See also preceding Abstract.] R. C. F.

4018. Isotope Effect in Neon Lines. E. Thomas and E. J. Evans. *Phil. Mag.* 10. *pp.* 128–134, *July*, 1930.

The results confirm those of Nagaoka and Mishima, though when the values of the separations of the lines are compared the agreement is not complete. The authors find that the value of $d\nu/\nu$ for the lines belonging to each Paschen series is practically constant within the experimental error, the values for the series $1s_2$–$2p_m$, $1s_3$–$2p_m$, $1s_4$–$2p_m$ and $1s_5$–$2p_m$, being 437, 367, 367 and 370×10^{-8}. For the first series the values of $d\lambda$ are on the average about 15 % lower than those of Nagaoka and Mishima, and for the last three series about 10 % higher. Using the formula $\nu = \mathrm{M}m/(\mathrm{M} + m)$, where M is the mass of the nucleus and m that of the electron, with atomic weights 20 and 22 for the two isotopes, $d\nu/\nu = 247 \cdot 4 \times 10^8$. It appears then that the simple theory does not apply to atoms with more than one electron. H. N. A.

4019. Structure and Activation of Phosgene Molecule. V. Henri and O. R. Howell. *Roy. Soc., Proc.* 128. *pp.* 178–192, *July* 1, 1930.

The investigation is presented in three parts: first, general considerations; second, Raman effect investigation; and third, ultra-violet absorption. The Raman effect gave three frequencies, 567, 444 and 290 cm.$^{-1}$. The infra-red absorption spectrum (Honegger, Marton) contains bands at 9010, 6896, 5405, 4167, 3660 and 2040 cm.$^{-1}$. All but the fifth of these occur also in acetone and acetaldehyde, and are due to CO. The ultaviolet absorption spectrum consists of about 270 bands between λλ3050 and 2380 Å. The absorption increases continuously towards the ultra-violet. The bands are doublets or triplets with a separation of 0·5 to 1 Å. The doublets can be attributed to chlorine isotopes. The rotation line are too close to be resolved. The vibration bands can be fitted to

$$1/\lambda = 33551 + 422p' - 582p_0 + 254q' - 302q_0 \quad \text{or}$$

$$1/\lambda = 33655 + 422(p' + \tfrac{1}{2}) - 582(p_0 + \tfrac{1}{2}) + 254(q' + \tfrac{1}{2}) - 302(q_0 + \tfrac{1}{2})$$

where $p_0 = 0, 1, 2$, $q_0 = 0, 1, 2, 3$, are the vibrational quantum members of the normal molecule, and $p' = 0, 1, 2, \ldots 12$, and $q' = 0, 1, 2, 3, 4, 5$, are those for the activated molecules. The vibration frequencies $\alpha_0 = 582$, $\beta_0 = 302$ cm.$^{-1}$ correspond to two of the Raman frequencies; 582 is attributed to the vibration of the chlorine atoms, 302 to that of the CO group.

" Predissociation " sets in at $p' = 7$, and activation of about 106,000 calories is required ($\lambda = 2700$). The photochemical decomposition of phosgene begins in this region. The deformability of the phosgene molecule lies between those of formaldehyde and of acetaldehyde and chlorine, with that of formaldehyde the least. The phosgene molecule, like those of formaldehyde and acetaldehyde, is regarded as a Y, with chlorine atoms at the tops, C at the join and O at the bottom. A. C. M.

4020. Apparatus for Raman Effect in Liquids. N. B. Reynolds and F. Benford. *Rev. Sci. Instruments,* 1. *pp.* 413–416, *July,* 1930.

Describes apparatus for routine Raman effect observation in liquids, employing Wood's device of a helium lamp, and the elliptical reflector of Dadieu and Kohlrausch [see Abstract 194 (1930)]. The helium tube is of the hot-kathode type, and is mounted parallel to the sample-tube. A filter of Corning red ultra glass round the lamp serves also to conduct the cooling water. A. C. M.

4021. Raman Effect and Atomic Linkages. N. B. Reynolds and J. W. Williams. *Frank. Inst., J.* 210. *pp.* 41–54, *July,* 1930.

Light scattering has been observed in benzene, nitrobenzene, toluene, ortho- and meta-nitrotoluene, para-nitrotoluene (dissolved in CCl_4), carbon tetrachloride, aniline, and orthochlorophenol. The apparatus used was that previously described [see preceding Abstract], employing helium excitation, and a large number of lines were observed (*e.g.*, in CCl_4, 48 lines). A molecular energy level scheme is drawn up for toluene. The line at 1335 cm.$^{-1}$ occurring in the nitro-compounds is attributed to a nitrogen-oxygen linkage. A. C. M.

4022. Raman Effect in Binary Mixtures. A. Dadieu and K. W. F. Kohlrausch. *Phys. Zeits.* 31. *pp.* 514–519, *June* 1, 1930.

Fifteen different mixtures of organic liquids, two at a time, are investigated in order to see if in all cases the Raman spectrum resulting is the superposition of the Raman spectra of the constituents. In general this seemed to be the case within the experimental error; but acetic acid and benzoic acid showed interesting small changes in the frequencies and intensities of lines due to the $C = O$ binding. It is thought that this is due to the high dipole moment of the $C = O$ group combined with the possibility of double molecules being formed. A. C. M.

4023. Raman Effect of the Cyanogen Group. A. Petrikaln and J. Hochberg. *Zeits. f. Chem.* 8. *Abt. B.* 5–6. *pp.* 440–444, *July,* 1930.

The Raman effect is observed for $Hg(CN)_2$, $KAg(CN)_2$, liquid cyanogen, KSCN, CH_3SCN, and $C_6H_5 . NCS$. A. C. M.

4024. Raman Spectrum of Nitric Oxide. F. Rasetti. *N. Cimento,* 7. *pp.* 261–269, *July,* 1930.

Nitric oxide is of particular interest, in that its fundamental level corresponds to a π term, and therefore a doublet series, whereas for all other stable diatomic gases it is a Σ term and therefore simple. To obtain photographs of the Raman lines produced by the mercury resonance line 2537, in close proximity to the unaltered line, the intensity of the latter must be greatly diminished, so that it does not mask the scattered lines. This was accomplished by inserting a globule of mercury in the apparatus, so that it absorbed only the unmodified radiation. The results obtained are in agreement with the general theory, and with the Kramers-Heisenberg selection rules. J. H. A.

4025. Raman Spectrum of Water. W. Gerlach. *Phys. Zeits.* 31. *pp.* 695–698, *July* 15, 1930.

Meyer [see Abstract 3438 (1930)] stated that the structure accorded to the Raman bands of water by the author was based on an optical illusion. The structure is here investigated more accurately than before, both subjectively and objectively with a registering photometer. It is clearly shown that the water band evoked by λ4047 Å. of mercury is a double band, with interval about 35 Å. (± 5). The effect of dissolved salts is investigated; it is found that nitrates shift the short-wave band to the violet, while chlorides tend to blot out the short-wave band. The difficulties in the way of accurate investigation of the structure of the Raman bands of water are discussed. A. C. M.

4026. Raman Spectrum of Water. E. H. L. Meyer. *Phys. Zeits.* 31. *pp.* 699–700, *July* 15, 1930.

Past investigations of the structure of the Raman bands of water are reviewed. While by ocular observation three components were seen, the photometer curve indicated no structure, for water, either at 30° C. or at 80° C. When nitric acid is added to the water, a second peak develops on the short-wave side in the photometer curve. At 1·5 mols. of HNO_3 per litre the effect is still unnoticed, but is clearly seen at 5·2 mols./litre, and the intensity of the new peak exceeds the original one at 14 mols./litre. [See also preceding Abstract.] A. C. M.

4027. Raman Spectra of Some Aldehydes and of Mesitylene. S. Venkateswaran and S. Bhagavantam. *Roy. Soc., Proc.* 128. *pp.* 252–262, *July* 1, 1930.

Light-scattering is investigated in acetaldehyde, paraldehyde, benzaldehyde, anisaldehyde, salicylaldehyde, cinnamic, capric, undecylic and lauric aldehydes, and also in mesitylene. All these aldehydes (except paraldehyde) exhibit a line in their spectrum at about 1700 cm.$^{-1}$, which is attributed to $C = O$. The " shift " of about 990 cm.$^{-1}$ which is strong in benzene, becomes weaker in mono-substituted and still weaker in di-substituted derivatives. It is surprising that it reappears very strongly in mesitylene. In practically all ten derivatives a fainter 1030 accompanies 990. The characteristic frequencies of certain groups are calculated on the basis of the method of Dadieu and Kohlrausch [see Abstract 1851 (1930)] with good results. A. C. M.

4028. Shifts in the Spectral Lines of Nickel by Disruptive Discharge. H. Nagaoka, T. Futagami and I. Machida. *Imp. Acad. Tokyo. Proc.* 6. *pp.* 248–251, *July*, 1930. *In English.*

The spectrum of nickel in the disruptive discharge is measured and examined in the way previously described for iron [see Abstract 3135 (1930)]. The nature of the shifts in nickel is similar to that in iron, but there are small differences in detail, and especially in the number of lines belonging to each type. The types of shift observed are attributable chiefly to Stark and temperature effects. C. B. A.

4029. Shifts in the Spectral Lines of Ionised Titanium by Disruptive Discharge. H. Nagaoka, T. Futagami and I. Machida. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 252–254, *July*, 1930. *In English.*

Titanium is examined in the same way as iron and nickel [see preceding Abstract]. The results do not entirely agree with those obtained by Russell, but the differences seem to depend on the strength of the discharge. C. B. A.

4030. Incomplete Paschen-Back Effect. J. B. Green. *Phys. Rev.* 36. *pp.* 157–160, *July* 15, 1930.

Darwin's calculations for the Zeeman effect have been applied to the most noted examples of discrepancy between the older quantum theory and experiment, those of the Cu $^2P^2D$ multiplet, and the Mg and Be $^3P^3S$ multiplets. The positions and intensities of the lines calculated are in very good agreement with the experiment. The distorted Zeeman patterns of $^3P^3D$ of Mg and $^2P^2D$ of Na are attributed to the action of the magnetic field on ^3P and ^2P separations. AUTHOR.

4031. Concentrating X-Rays. M. Pierucci. *N. Cimento,* 7. *pp.* 245–247, *June,* 1930.

X-rays are reflected by a short mica cylinder, on the axis of which the source is situated. The rays of a certain frequency are found concentrated on a point in the axis. A large number of such short mica cylinders of various diameters are mounted together under a flat cardboard cover. They yield a beam containing rays of all frequencies concentrated in a space a few mm. in width and depth. E. E. F. d'A.

4032. Excitation of Soft X-Rays from Single Crystal Surfaces and from Polycrystalline Surfaces of Graphite and Aluminium. O. W. Richardson and Ursula Andrewes. *Roy. Soc., Proc.* 128. *pp.* 1–15, *July,* 1930.

An attempt to improve and extend the experiments of Richardson and Chalklin [see Abstract 2410 (1928)]. The method consists of bombarding the target with electrons from a glowing filament and measuring the photoelectric current produced when the soft X-rays generated by this bombardment fell on a nickel plate. The photoelectric current per unit thermionic current is then plotted against the voltage as this increased in small steps and discontinuous changes of slope in the resulting curves are observed. The results show that there are a large number of discontinuous changes in the soft X-ray emission from carbon and aluminium which have nothing to do directly with processes equivalent to the displacement of electrons in atomic orbits. The results obtained with single crystals as against polycrystalline surfaces indicate that the simpler the crystal structure of the surface the fewer the number of critical potentials. The critical potentials may be arranged in groups having the same sort of numerical relationships as the frequencies of lines in a set of bands. J. E.

4033. Excitation of Soft X-Rays from Some Polycrystalline Surfaces. O. W. Richardson and S. R. Rao. *Roy. Soc., Proc.* 128. *pp.* 16–36, *July* 1, 1930.

The metals investigated were nickel, copper, cobalt and tungsten. The apparatus and methods were very similar to those used in the previous paper [see preceding Abstract]. Again, more discontinuities in the X-ray emission are observed than can be accounted for by the X-ray term values for the atoms of the target, when the voltage is increased in very small steps. It appears most unlikely that any considerable proportion of these discontinuities can be accounted for by the presence of impurities or by any discontinuous variation of the photoelectric current per unit thermionic current with increase of the thermionic current. J. E.

4034. Excitation of Soft X-Rays from a Single Crystal Face of Nickel. O. W. Richardson and S. R. Rao. *Roy. Soc., Proc.* 128. *pp.* 37–41, *July* 1, 1930.

The face of the crystal used represented the 100 plane. Care was taken during the degassing of the apparatus not to heat the crystal face above 1000° K., so as to avoid any breakdown of the structure. In the range worked over, 45 to 300 volts, the curves representing X-ray emission against voltage show fewer inflections than the corresponding curves for the polycrystalline surface [see preceding Abstract]. Moreover, working with larger step increases of voltage over a big range the intensity curve shows a saturation tendency at the higher voltages for the single crystal, while for the polycrystalline surface the intensity varies roughly as the potential. J. E.

4035. Total Secondary Electron Emission from Polycrystalline Nickel. S. R. Rao. *Roy. Soc., Proc.* 128. *pp.* 41–56, *July* 1, 1930.

Richardson has shown that at every potential where there is an increased emission of X-rays there is correspondingly an increase in the emission of secondary electrons, and has discussed at some length the mechanism of the generation of secondary electrons [see Abstract 3046 (1928)]. Davisson and Kunsman [see Abstract 592 (1924)] and Farnsworth showed that the total emission of secondary electrons from a metal surface depended on the applied potential, the nature of the surface and the previous heat treatment, and that the ratio of the secondary beam to the primary beam increased with the voltage becoming greater than one at a voltage characteristic of the metal. Krefft [see Abstract 709 (1928)] showed that discontinuities exist in the secondary electron emission coinciding with the X-ray discontinuities. In these experiments a method similar to that of Krefft is used with some improvements. Up to 30 volts a number of peaks are obtained in the secondary emission; beyond 30 volts a number of inflections in the secondary emission curves. Although the number is much less than that of the X-ray discontinuities, almost every value obtained with secondary electrons coincides with an X-ray value. Investigations as to the effects on the curves of adsorbed hydrogen showed that it is improbable that adsorbed gases contributed many of the discontinuities. A total secondary electron curve obtained over the range 30 to 550 volts shows that the secondary emission per unit primary current increases linearly up to 225 volts; after this the curve bends gradually to become nearly horizontal at 500 volts. J. E.

4036. Total Secondary Electron Emission from a Single Crystal of Nickel. S. R. Rao. *Roy. Soc., Proc.* 128. *pp.* 57–62, *July* 1, 1930.

In this paper the results of experiments on the 100 face of a single nickel crystal are given. In the range 1 to 30 volts only two peaks are observed indicating that the more numerous peaks obtained with the polycrystalline surface [see preceding Abstract] are due to reflection or diffraction from the various crystal faces of different orientations. In the range 30 to 550 volts, 15 inflections are obtained, 11 of which coincide with X-ray inflections [see Abstract preceding the above] showing that at every potential where there is increased X-ray emission there is corresponding increase in the secondary electron emission. It appears that the conditions which give rise to large scattering of electron waves are also such as give rise to increased X-ray emission. J. E.

4037. Emission of Secondary Electrons and the Excitation of Soft X-Rays. O. W. Richardson. *Roy. Soc., Proc.* 128. *pp.* 63–74, *July* 1, 1930.

A new discussion based on the results of recent experiments [see preceding five Abstracts]. There appear to be three groups of secondary electrons; those due to reflection without loss, those due to inelastic collisions and a third group originating in some way as a result of the excitation accompanying the inelastic collisions. The energy losses in the inelastic collisions correspond to level differences which are independent of the energy of the exciting electrons, and the energy distribution in this third group is very similar to that of the photoelectrons generated by soft X-rays. This similarity suggests that these photoelectrons and the third group of secondary electrons originate in a mechanism of the same type. In order to harmonise the experimental facts it is suggested that in a crystal there are extra-atomic electrons which are not free but which are associated with the crystal structure, called structure electrons. According to this picture, when an electron reaches a crystal surface it is either diffracted by the crystal grating or it reacts with one of the structure electrons raising the energy of this from a normal to an excited state. The energy of this excited structure electron is then radiated, part escaping and giving the soft X-rays and part acting photoelectrically and causing the ejection of secondary electrons. This would account for the similarity in the velocity distribution among the true secondary electrons and that of the low velocity group generated by soft X-rays and for the agreement between the secondary electron and soft X-ray discontinuities. The hypothesis gives a natural explanation of the bandlike structure of the discontinuities, while the level differences indicated by the X-ray data and the velocity distribution of the secondary electrons are of the same order of magnitude as those to be expected theoretically. J. E.

4038. New Results of the Magnetic Spectroscopy of X-Ray Electrons. H. R. Robinson and C. L. Young. *Roy. Soc., Proc.* 128. *pp.* 92–114, *July* 1, 1930.

Details of the method have already been given in previous papers [see Abstract 1416 (1927)]. The primary radiation used in the new work was silver K + "white"—practically unfiltered radiation from a gas-filled tube with silver antikathode. The corresponding X-ray frequencies, the estimated intensities and the level of origin of the emitted electrons are given in tabular form for uranium (oxide), bismuth (oxide), lead (element), gold (element), cerium (oxide), silver (element), molybdenum (element), zirconium (oxide), strontium (oxide), copper (element). As regards the relative intensities of the lines in secondary kathode ray groups the new data bring out clearly the effect that in a given group the lines corresponding to levels of smaller azimuthal quantum number, which are relatively weak when the primary radiation is just hard enough to excite all members of a group, become relatively more intense with increasing frequency of the primary radiation. The "fluorescent lines" and their origin are also discussed, and are attributed to internal conversions of the stronger characteristic X-rays of the target. W. S. S.

4039. Precision Measurements of Glancing Angle of Reflection from Calcite for Silver ($K\alpha_1$-) X-Rays by the "Method of Displacement." C. D. Cooksey and D. Cooksey. *Phys. Rev.* 36. pp. 85–109, *July* 1, 1930.

The "method of displacement" is carried out by allowing a properly limited beam of X-rays to fall, after reflection, on a photographic plate placed successively in two parallel positions separated by a known distance. Apparatus, adjustments, experimental procedure and theory of the method are discussed. The weighted mean value of the glancing-angle for the $K\alpha_1$ line of silver from the cleavage planes of calcite at 18° C. is $5^\circ\ 17'\ 13\cdot81'' \pm 0\cdot06''$, giving $\lambda = 0\cdot558238$ Å. This value differs from Kellström's value by more than ten times the combined probable errors. Compton's measurements of the density of calcite suggest that different specimens of calcite differ sufficiently in density to account for more than the discrepancy, provided that changes in density and grating space are interdependent. J. S. G. T.

4040. Fine Structure of the K-Radiation of the Lighter Elements. L. Y. Faust. *Phys. Rev.* 36. *pp.* 161–172, *July* 15, 1930.

A vacuum spectrograph of simple construction is described in which it is possible to maintain bombarding currents of 150 mA. With a line grating on glass (1179 lines per mm.) photographs, some measurable in the second and third orders have been obtained of the soft X-radiation from beryllium, boron, oxygen and carbon, also from tungsten and certain heavier elements. Under analysis with a thermoelectric densitometer the K lines of the lighter elements, excepting oxygen, were found to be complex. The K-radiation of boron compounds contained thirteen components, that of " pure " boron four, that of carbon nine, whereas the beryllium radiation was still more complex. The relative intensities of these components was shown to depend on the energy used in stimulating them. The representative wave-length selected for the $K\alpha$ line was for oxygen 23·7 Å., for boron 69·3 Å., for carbon 45·3 Å., while for beryllium the radiation embraced more than 15 Å. with maxima at 107·2, 113·2 and 118·7 Å. The complex structure is thought to be partly a true fine structure and partly a system of satellites due to interaction with associate dissimilar atoms. A possible hypothesis is suggested in explanation of these results. AUTHOR.

4041. Secondary Radiation of Solid Elements in Relation to the Material of the Radiator and the Hardness of the Exciting X-Rays. E. Vette. *Ann. d. Physik*, 5. 8. *pp.* 929–990, *July* 26, 1930.

The secondary electron emission of 24 elements between Al and Bi was investigated by the ionisation method. The exciting radiation was that emitted from a tungsten target X-ray tube, excited between 20 and 180 kV. after filtration *via* Cu and Al. It was shown the spectral partition was only dependent upon the coefficient of absorption. Secondary electron emission was absorbed by a thickness of 0·025 mm. of cellophane. Errors due to secondary emission of the ionoquantimeter walls were reduced to a small value by the use of a large ionisation chamber. The characteristic secondary radiation showed the well-known discontinuities at the regions of characteristic absorption. Because of the photoelectric effect and the Compton effect, all elements between Al and Fe showed an intensity maximum for X-rays of medium intensity at about 0·15 Å., and likewise for the heaviest elements, but for elements of medium atomic weight the maximum was more towards the shorter wave-lengths. Variation of the filter thickness showed that, with monochromatic radiation of the same wave-length as the limiting wave-length of the non-filtered radiation, there was no noticeable alteration of the normal emission. With elements having an absorption band in the wave region utilised, the normal and characteristic emission could not be separated. For the same region of the exciting X-rays, the theory of Holthusen and Ascher, as regards electron emission, was obeyed, there being an increase with atomic number until an absorption band is reached, with a fall and subsequent rise. The increase of electronic emission is most marked for radiation of medium hardness (0·15 Å.). The absorption curve of cellophane showed increase of secondary electron velocity, with increase of hardness of the exciting radiation and decrease of velocity, with increase of atomic number of the irradiated element. By the use of multiple layers, each of some μ thickness, of the radiator, it was determined for Al, Ni and Au, how far the deeper layers of the element affected the electron emission for various hardnesses of the incident X-rays. At 180 kV and with 10 mm. Cu filter the limiting thickness was 44 μ for Al and about 20 μ for Ni and Au. The paper is largely tabular with many graphs. B. J. L.

4042. Influence of Temperature and Dissolved Electrolyte on the Structure of Water. H. H. Meyer. *Ann. d. Physik,* 5. 6. *pp.* 701–734, *July* 7, 1930.

The influence of temperature and dissolved electrolytes (LiCl and NaCl) on the monochromatic diagram of water was investigated by the method of Debye and Scherrer. CuKα- or MoKα-radiation made monochromatic by reflection at a NaCl crystal was used, and the photometric results are given in curves and tables. From these it appears that the Debye-Scherrer diagram of water at 20° C. has four maxima corresponding with the identity periods 3·132, 2·12, 1·34 and 0·89 Å., calculated according to Bragg's equation. With increasing temperature of the pure water and increasing concentration of the dissolved electrolyte the positions and values of the maxima are changed in the same sense. With 8N LiCl solution the second maximum disappears. The observed changes are in agreement with the hypothesis that the first maximum is due to interference at the separate molecules, the second to interference at the molecules within the molecule complexes. The complexes are large and must contain in some cases approximately 1000 individual molecules. J. J. S.

4043. Influence of Chemical State on Critical X-Ray Absorption Frequencies. H. R. Robinson and C. L. Young. *Phil. Mag.* 10. *pp.* 71–75, *July,* 1930.

The element or compound under examination is made the "target" of a bombardment by homogeneous X-radiation, and pencils of the resulting kathode rays are defined by a suitable slit system, being guided and focussed by a uniform magnetic field in such a manner that they produce accurately measurable traces on a photographic plate. It is found that the K line of $Cr(OH)_3$ is displaced, relative to that of the element, so that the secondary kathode rays emerge from the K level of the chromium atom in the compound with appreciably smaller velocities than those from the K level of the element. Lindh's report [see Abstract 2074 (1927)] should be consulted for an account of the subject-literature. H. H. Ho.

RADIOACTIVITY.

4044. Improved Procedure for Determination of the Radium Emanation Content in the Free Air. W. Kosmath. *Gerlands Beitr. z. Geophys.* 27. 1. *pp.* 42–46, 1930.

It is shown that the method described earlier [see Abstract 2220 (1930)] using coco-nut charcoal to determine the Ra Em content is not very suitable since two to four hours are required for each measurement, and in this time changes may occur. The requirements of a new improved method are stated, and a method described which satisfied these conditions, each test requiring only 10 min. This procedure is important for bioclimatic, balneological and medicinal questions, and is also practicable for aircraft and balloon ascents. R. S. R.

4045. Determination of Period of Radium C′ and Experiments with Thorium C′. F. Joliot. *Comptes Rendus*, 191. *pp.* 132–134, *July* 21, 1930.

The period of radium C′ has been determined by a slight modification of Jacobsen's method [see *Nature*, 120. pp. 874–876, Dec. 17, 1927] as $(3 \pm 1\cdot 5) \times 10^{-6}$ sec. In spite of considerable divergence in the results, it was quite clear that there was no trace of a maximum in the (number of α-particles)/(distance from source) curve. Jacobsen's results in this respect are attributed to variation in the observed effect of the reflection of the recoil atoms according to the relative positions of source and observation tube. A similar experiment with thorium C′ shows its period to be much less than 10^{-6} sec. There is no evidence in support of Jacobsen's suggestion of an interval between the emission of the nuclear electron and of the quantum γ. C. A. S.

4046. Scattering of α-Particles in Helium. J. Chadwick. *Roy. Soc., Proc.* 128. *pp.* 114–122, *July* 1, 1930.

Mott has shown that according to wave mechanics the α-particles scattered by helium gas should interfere with the projected helium nuclei travelling in the same direction. This follows from the precise similarity of the α-particle and the helium nucleus. The interference results in the scattering intensity varying above and below the value deduced on the classical theory, assuming the inverse square law, at 45° the quantum theory giving double the classical intensity. The experiments here described employ the annular ring method as adapted by Rutherford and Chadwick for observation of scattering by a gas. To avoid determination of the constants of the apparatus, the helium scattering was compared with that of argon gas for which the classical scattering has been established by previous work for all α-particle velocities worked with here. The observations show quite definitely that for sufficiently slow α-particles the amount of scattering at 45° is double that of the classical theory. For faster α-particles the inverse square law breaks down and other radical deviations from the classical law set in. W. S. S.

4047. Tube Counters of Geiger and Müller. B. Rossi. *Accad. Lincei, Atti*, 11. *pp.* 831–836, *May* 4, 1930.

Referring to his arrangement of the tube counters of Geiger and Müller described in a former paper [see Abstracts 3171 (1930) and 1237 (1929)], the author by a modification of this arrangement has tested whether (and under what conditions) the counter indicates all the corpuscles which traverse it, and when this does not happen, what is its "yield," and if this is the same in all the sections of the counter. By yield is meant the ratio between the number of the corpuscles that are revealed and the total number of the corpuscles that traverse the counter. It was found that the counters have the same yield in all the sections; this yield increases on raising the applied tension up to a limit which cannot be exceeded on increasing further the tension and whose value depends on the resistance of discharge. J. J. S.

4048. Sensitive Surface of Geiger Tube Electron Counter. L. F. Curtiss. *Bureau of Standards, J. of Research,* 4. *pp.* 601–608, *May,* 1930.

Experiments with the new Geiger tube electron counter [see Abstract 3764 (1930)] show that no preparation of the central wire electrode is necessary in contradiction to results reported by Geiger [see Abstract 1099 (1930)]. Such wires as bare copper, bare steel, lacquered steel, oxidised tungsten and oxidised nichrome work satisfactorily. All these wires cease to work when such gases as H_2S, SO_2, ethylene or water vapour are admitted. This shows that at the pressure at which these counters work sufficient oxygen is adsorbed to permit the counter to operate. When another gas with different adsorptive properties is admitted, the counter can no longer function. [See also following Abstract.] AUTHOR.

4049. Geiger Tube Electron Counter. L. F. Curtiss. *Bureau of Standards, J. of Research,* 5. *pp.* 115–123, *July,* 1930.

Experiments are described which show that the sensitive surface of the Geiger tube counter is not on the wire electrode, but on the inner surface of the tube. This result explains the previously observed result [see preceding Abstract] that the operation of the counter is only slightly affected by the condition of the surface of the wire electrode. An explanation of the operation of the counter is offered which takes account of this additional information. AUTHOR.

4050. Use of Geiger's Point Counter for Measuring Slow Electrons. J. Hornbostel. *Ann. d. Physik,* 5. 8. *pp.* 991–1016, *July* 26, 1930.

The point counter has been used for investigating the slow electrons liberated from thin layers of magnesium and of celluloid by hard and soft X-rays. The stream of electrons was sufficiently accelerated, just before they reached the point counter, by means of an electrostatic field to enable them to penetrate the foil which closed the opening of the counter. To increase the sensitiveness of the arrangement, by eliminating scattering of the electron stream to the sides, a longitudinal magnetic field was introduced, round the lines of force of which the electrons travelled in spirals. The original velocity of the electrons was measured by means of an opposing electrostatic field. The "yield" of the apparatus was determined to within 20 or 30 %. Curves were obtained for the distribution of velocity in the different cases, and notches were found in them which originate in the electrons produced in the Meitner-Auger process. A new method for dealing with a stream of electrons spectroscopically is worked out. The electrons are deviated in proportion to their velocity by means of a longitudinal magnetic field, and an electrical field at right angles to it. H. N. A.

HEAT.

4051. New Adiabatic Calorimeter. W. H. Barnes and O. Maass. *Canad. J. of Research*, 3. *pp*. 70–79, *July*, 1930.

A new adiabatic calorimeter equipped with a radiation thermel is described. Measurements of the heat capacity of ice over various temperature ranges are presented in order to illustrate the method of handling the calorimeter and to find the order of accuracy of this piece of apparatus. The latent heats of fusion of ice at 0° C. and at − 3° C. are found. The novel feature of the new calorimeter is shown to be the radiation thermel for indicating any difference between the temperatures of the inner calorimeter and the outer bath. This instrument consists of a multiple junction thermocouple of which one set of junctions receives heat from the inner calorimeter vessel by radiation. The accuracy of the calorimeter is shown to depend on the magnitude of the temperature drop in the inner vessel and on the method for reading the temperatures involved. In the experiments with ice a probable accuracy of about 0·2 % is obtained with temperature drops of the order of 2°, measurement of which is made with a Beckmann thermometer. AUTHORS.

4052. Calorimetry in Furnaces. W. P. White. *J. Phys. Chem.* 34. *pp*. 1121–1136, *June*, 1930.

The two methods generally employed in calorimetry at high temperatures are (1) the " dropping " method, where the body investigated is heated in the furnace to one temperature after another, and (2) a method where the body is heated either electrically or by " radiation " from the furnace wall [see Abstract 2765 (1928)]. The former method has given us most of our reliable data. " Twin " calorimeters are valuable, especially for eliminating the effect of changes in furnace rate. It is stated that the temperature should generally be measured at the wall of the calorimeter. Electric heating is practically indispensable for determining latent heats, but is of less value for specific heats. The precision obtainable depends greatly on the compactness, permanence, and insulating quality of the material, and decreases considerably as the temperature rises. In no case does the precision of furnace calorimetry seem likely to be better than 1 %. Experiments are described in illustration of some of the points discussed. T. B.

4053. Specific Heats of Nitrous Oxide, Ammonia and Hydrogen Fluoride from 10° Abs. Upwards. K. Clusius, K. Hiller and J. V. Vaughen. *Zeits. f. phys. Chem.* 8. *Abt. B*. 5–6. *pp*. 427–439, *July*, 1930.

Since with carbon dioxide a small deviation between the vapour-pressure constant and the chemical constant has been demonstrated [see Abstract 1524 (1930)], a similar investigation on nitrous oxide is of interest. The small steel bomb used as calorimeter is described. The surface of the calorimeter is supplied with a fine lead wire, and it is thought that between 20° and 80° Abs. this wire gives measurements of temperature that agree with those obtained by a platinum thermometer. Between 10° and 30° Abs. the measurements with ammonia are obtained in a similar calorimeter of copper, but at the higher temperatures a glass calorimeter is used, and a pure platinum wire for temperature measurement. With hydrogen fluoride a silver vessel and a lead wire are used. The experimental results are given in three tables, and a graph that plots the molar heat of nitrous oxide against absolute temperature. Below 18° Abs., in the case of nitrous oxide, a good interpolation of the observations is obtained with a θ-value of 126° for the Debye function. The T^3-law can be confirmed for ammonia; and below 20° Abs. the observations for this gas are represented by the relation, $C_p = 4 \cdot 73 \, . \, 10^{-5}T^3$. In regard to hydrogen fluoride, the association into H_2F_2 seems to be continued in the solid state. The vapour-pressure constant of nitrous oxide is 0·857, while the true chemical constant is found to be 0·695. T. B.

4054. Rotational Specific Heat and Rotational Entropy of Simple Gases at Moderate Temperatures. G. B. B. M. Sutherland. *Cambridge Phil. Soc. Proc.* 26. *pp.* 402–418, *July,* 1930.

In the first part of this paper rotational specific heat is treated mathematically. The rotational entropy of oxygen and of nitric oxide has recently been calculated from spectroscopic data by means of a rather laborious summation method. In the second part of the paper the asymptotic expansions obtained in the first part are applied to the derivation of formulæ for the rotational entropy of simple gases at moderate temperatures which enable the calculations to be made without using any summation of series. J. J. S.

4055. General Formula for the Dependence of Density of Standard Liquids upon Temperature. E. Salzwedel. *Ann. d. Physik,* 5. 7. *pp.* 853–886, *July* 16, 1930.

The curve relating the density *s* of a liquid with temperature T is roughly a parabola with its vertex at the critical point T_c. Thus $s_T - s_{T_c} = \lambda\sqrt{T_c - T}$, where λ is a function of the temperature. The behaviour up to the critical point is more precisely represented by an equation defining λ in terms of three other constants; hence *s* may be determined over the entire liquid range if its values at five different temperatures are known. The equation permits interpolations for the critical value s_{T_c} and for the melting point, and takes the same form whether the values of *s* are obtained under a variable (saturated vapour) pressure or under a constant pressure equal to the critical pressure. The values of s_{T_c} derived for water, ethyl and methyl alcohols and carbon tetrachloride are all some 20 % below those previously accepted. The physical justification for the difference is yielded by experiments on methyl alcohol, giving the values $T_c = 240°$ C., $p_c = 99$ atmospheres, $s_{T_c} = 0 \cdot 3587$ gm./cm.^{3} and melting point $-98 \cdot 2°$ C. These values agree with those calculated in the way described. It appears that the liquid and the gas merge into one phase before their densities attain the same value, *i.e.*, before the true critical pressure is reached; hence the experimental criteria of Cailletet and Mathias are insufficient. The author proposes a new definition of the critical temperature as the highest temperature at which condensation is possible. L. V. C.

4056. Vapour Pressure and Vapour Density of Sodium. W. H. Rodebush and E. G. Walters. *Am. Chem. Soc., J.* 52. *pp.* 2654–2665, *July,* 1930.

The vapour pressure of sodium measured over the temperature range

from 650° C. to 850° C. conforms to the equation $\log P_{mm} = 7\cdot5510 - 5400\cdot0/T$, which gives good agreement with previous data down to pressures of 10^{-4} mm., and indicates the presence of an appreciable amount of Na_2 molecules in sodium vapour. Vapour-density measurements at 570·5° C. and 705·8° C. give values for the apparent molecular weight which, at the lower temperature, are in fair agreement with the value calculated from spectroscopic data [see Abstract 2955 (1927)].
A. J. M.

4057. Kinetic Theory of Vaporisation. Part III. Vapour Pressure of Solutions. S. C. Bradford. *Phil. Mag.* 10. *pp.* 160–185, *July*, 1930.

In former papers [see Abstract 562 (1926)] Maxwell's theory of the distribution of molecular velocities was amplified to take into account the effects of molecular attraction. The extended theory is now applied to the vapour pressures of pure liquids and solutions in terms of molecular attraction, motion and velocity only. Agreement between calculated and observed values is very close. Formulæ are given for vapour pressures of a pure liquid and of a solution. It is also shown that the total average velocity of the molecules in a liquid cannot be the same as in a perfect gas, and the following equations are given showing the ratio λ of the two velocities in terms of the cohesion K of the liquid:

$$K \times 10^{-8} = 42\cdot16y - 64\cdot7y^3 + 952y^5 \text{ and } \lambda = 1 + y.$$

T. B.

4058. Gibbs-Dalton Law of Partial Pressures. L. J. Gillespie. *Phys. Rev.* 36. *pp.* 121–131, *July* 1, 1930.

Various formulations of Dalton's law are investigated thermodynamically. The Gibbs formulation is equivalent to the statement: "The concentration of a gas is the same at equilibrium on either side of a membrane permeable to it alone." The ordinary form of Dalton's law has only a limited equivalence with the Gibbs form. The Lewis and Randall rule of fugacity is in many ways analogous to the Gibbs-Dalton law. Application to experimental data shows that the Gibbs-Dalton law, like the Lewis and Randall rule, though possible for gases which do not follow Boyle's law, is only an approximation. In the cases examined, the errors are opposite in sign to those of the Lewis and Randall rule. An outline is given for the application of the Gibbs-Dalton law to the study of the equilibrium in gases, and the useful field of application is indicated.
T. B.

4059. Rational Basis for the Thermodynamic Treatment of Real Gases and Mixtures of Real Gases. J. A. Beattie. *Phys. Rev.* 36. *pp.* 132–145, *July* 1, 1930.

From the general laws of thermodynamics and two isothermal assumptions it is shown that the following relations hold at infinitely low pressures: (1) The ratio of the equilibrium pressure of a gas to the product of its mole fraction in the mixture multiplied by the total pressure of the mixture is unity. (2) The ratio of the equilibrium concentration of a gas to its concentration in the mixture is unity. (3) The ratio of the sum of the equilibrium pressures of the component gases to the total pressure of the gas mixture is unity. (4) The entropy, energy, heat content, thermodynamic potentials, and heat capacities of a mixture of gases are equal respectively to the sums of those of the component gases existing each by itself with the same value of its volume, temperature and chemical potential as in the mixture. (5) The energy, heat content and heat capacities of pure gases and of gas mixtures of constant composition are functions of the temperature. (6) The difference of the heat capacity at constant pressure and that at constant volume of a pure gas or of a gas mixture is equal to the product of the total number of moles present multiplied by the gas constant R. (7) The pressure-volume product for a pure gas or for a gas mixture is equal to the product of the total number of moles present multiplied by RT, where R is a universal constant and T the Kelvin temperature. T. B.

4060. Friction, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part IX. Concentration Function of the Diffusion Constant of Gases. M. Trautz and O. Ludwig. *Ann. d. Physik*, 5. 7. *pp.* 887–918, *July* 17, 1930.

A further paper of the series [see Abstract 3778 (1930)]. The diffusion constant (D) can be deduced from the time relationship of a diffusion processor from the stationary conditions of the quantity of material moved or transported. The second method is the simpler and is treated in the present paper. The phenomenon of vaporisation in a stationary diffusion process is examined and the diffusion constant of vapour in gas is measured experimentally to within 1 to 1·5 %. The earlier methods for the determination of the value of D are criticised, both as to the technique employed and the apparatus used. All theoretical work gave differential and all practical work gave integral (mean) values for the diffusion constants. The relationship of the differential value of D to the value of C is deduced, *i.e.*, the dependence of the concentration upon the initial concentration is examined over a time range. The non-stationary method and the vaporisation method are studied and compared. The deviation from the Stefan-Winkelmann-Wuppermann vaporisation method is shown as being partially due to the apparatus used, partially to the technique employed, and partially to quantitative methods of calculation. The relative values of D according to the vaporisation method are correct to within 0·5 to 1·0 %. Stationary vaporisation investigations upon mixtures of ($C_6H_6 - H_2$) and ($C_6H_6 - O_2$) at 23° C. gave the values of D independent of the gas flow in addition to the times, heights and strengths of the diffusion currents. For the two above-mentioned cases the expression DM is shown to be tolerably constant. The method is extended to the use of vapour-laden gases. In the two cases quoted above measurements were made up to 90 % of H_2 and O_2 present in the mixtures. [See also following Abstract.] S. G. B.

4061. Friction, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part X. Whole Number Constant Ratios and Quantum Number Conditions in Gaseous Friction. M. Trautz. *Ann. d. Physik*, 5. 7. *pp.* 919–928, *July* 17, 1930.

A further paper of the series [see preceding Abstract]. The paper opens with a discussion of the definition and accuracy of the temperature invariant constants of gaseous friction, *e.g.*, T exponent (n), the Sutherland constant (C), the quantities (q) ($M\theta$), and ($F_{\text{geom.}}$), etc. The methods used for their determination are briefly discussed. The relationships between the various quantities involved and the individual characteristics of each factor are given at length. S. G. B.

4062. Upper Limits of Energy Density and Their Thermodynamical Consequences. S. Suzuki. *Phys. Zeits.* 31. *pp* 618–623, *July* 1, 1930.

The author recently deduced the range of the upper limits of energy density from the Planck radiation formula. Consequent upon a paper by Pokrowski [see Abstract 47 (1929)], the results of which may be combined with those of the author, further results are obtainable. The energy density is shown to be incapable of increase indefinitely, and when the assumptions now made are considered in the light of the new wave mechanics the finiteness of the energy content is established. The paper is mathematical and theoretical. S. G. B.

4063. Relation $E = h\nu$ in Undulatory Mechanics. E. Persico. *Accad. Lincei, Atti*, 11. *pp.* 985–988, *May* 30, 1930.

The relation $E = h\nu$ is usually introduced in undulatory mechanics as a postulate, suggested by the experimental fact that in all the changes of energy between radiation and matter the relation holds good. But considering that in such phenomena ν represents the frequency of an electromagnetic radiation which is quite different from de Broglie waves such a postulate does not appear plausible *a priori*. The justification from its success does not prove in fact the necessity of establishing between E and ν precisely the relation $E = h\nu$. The author shows that it is not necessary to admit this relation as a postulate, because if it is admitted only that the frequency of the de Broglie waves stand in any relation whatever with the energy it may be proved that this relation *must* be $E = h\nu + b$, where b is a constant quite arbitrary with non-relativistic considerations, but fixed with relativistic. The constant b is the ordinary additive constant of the energy. The most general assumption, without the intervention of relativistic considerations, is that $E = h\nu + b$. On the choice of b will depend the frequency and the phase velocity of the de Broglie waves, but not the wave-length, nor the group velocity that alone are measurable: hence, accord with experiment occurs with any value of b and in particular with $b = 0$. J. J. S.

4064. Nature of Planck's Constant. P. Drumaux. *Ann. Soc. Sci. de Bruxelles*, 50. *pp.* 73–76, *July* 11, 1930.

The notions of space, time, movement and matter which lie at the base of all physics are such that no one can be defined without appealing to the others, *i.e.*, they are inseparable. In particular, matter and movement are inseparable concepts. This is translated into an equation $x = y$, where x is a number representing matter, y a number representing movement. Arguments are advanced for choosing x as a mass m and y as a frequency ν, and to allow for the arbitrariness of systems of units, a constant k is introduced leading to the equation $m = k\nu$. In accordance with relativity m represents energy, $\epsilon = mc^2$, whence $\epsilon = kc^2\nu = h\nu$. $h = kc^2$ appears as a universal constant on the same footing as k or c. Thus, Planck's equation $\epsilon = h\nu$ expresses the inseparability of the notions of matter and movement. W. S. S.

SOUND.

4065. Velocity of Ultrasonic Waves in Water Vapour. G. E. Thompson. *Phys. Rev.* 36. *pp.* 77–79, *July* 1, 1930.

The velocity of sound waves having a frequency of 108,600 ∼ per sec. has been measured in water vapour by a method similar to that used by Pierce [see Abstract 341 (1926)] for other gases. At a temperature of 27° C. the velocity is 432 m. per sec. [See also Abstract 2881 (1930).] AUTHOR.

4066. Ultrasonic Stationary Waves Rendered Visible in Gases by the Method of Striations. E. P. Tawil. *Comptes Rendus,* 191. *pp.* 92–95, *July* 16, 1930.

A comprehensive description is given of a new method whereby ultrasonic stationary waves may be rendered visible or photographed by utilising variations of refractive index in a gas at different points of disturbance. Typical illustrations are included. **Errata,** *ibid.* p. 168, July 21, 1930. H. H. Ho.

4067. Bells. F. G. Tyzzer. *Frank. Inst., J.* 210. *pp.* 55–66, *July,* 1930.

The characteristics of bell vibrations were studied by using a valve maintained electromagnetic device to excite the bell vibrations continuously. The resulting motion was studied by a listening device which incorporated a gramophone sound-box. The pitch of the three bells studied was that of the second partial which was about an octave below the fifth partial. W. H. GE.

4068. Fingering of Wind Instruments. E. J. Irons. *Phil. Mag.* 10. *pp.* 16–27, *July,* 1930.

Experimental measurements show that the impedance theory is capable of predicting the frequencies of the tones emitted by the flageolet to within 1 or 2 %, and to indicate the trend of the results obtained with an auxiliary whistle formed by fitting the auxiliary mouthpiece with a tube of the same cross-section and length as the flageolet. Since the impedance of a conical horn is known it is possible to extend the argument to instruments having that form. W. H. Ge.

4069. Automatic Reverberation Measurement. E. Meyer. *Zeits. f. techn. Physik,* 11. 7. *pp.* 253–259, 1930.

Detailed description with diagrams of special valve circuits and relays by which a stop-watch can be started and automatically stopped when the pressure amplitude of the sound reaches a definite fraction of the initial value which it had when the sound was stopped to test the reverberation properties of the enclosure. The method is used to study the influence of atmospheric humidity on the absorption of sounds of different frequency and it is shown that the absorption is less for the higher frequencies. The method is also used to study the decay of sound from a tuning fork mounted on its resonance chamber. W. H. GE.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM

4070. Deformation of Soap Bubbles in Electric Fields. W. A. Macky. *Cambridge Phil. Soc., Proc.* 26. *pp.* 421–428, *July*, 1930.

The method is similar to that used by C. T. R. Wilson and G. I. Taylor [see Abstract 2331 (1925)], save that both plates are connected to the poles of a Wimshurst machine, the potential being adjusted by varying the distance of a point on the negative plate; and that instead of the bubble being placed directly on the wetted plate a shallow cavity was made in the lower plate and the bubble placed on soap solution contained therein. The phenomena are similar to those previously observed until the field is sufficient to cause vibration, the strength for which is the same for a positive or negative bubble, varying inversely as its radius. Thereafter the positive bubble always bursts quickly, but the negative bubble does not usually do so until some protuberance (*e.g.*, splashed soap solution) on the positive plate causes a spark to pass. Photographs of bubbles in various stages are given. Preliminary experiments with water drops indicate that these are distorted in a very similar manner, and that a drop of radius 0·18 cm. is disrupted by a field of about 9000 volts/cm.

C. A. S.

4071. Dielectric Constant of Liquid Bromine. D. Doborzynski. *Acad. Polonaise Sci. et Lettres, Bull.* 34. *pp.* 97–111, *March*, 1930. *In French.*

Previous work is first briefly reviewed [see Abstract 1705 (1928)] and a description then given of the measurement of the dielectric constant of liquid bromine within the temperature range 0°–53·8° C., by the resonance method. The results are expressed by the formula: $\epsilon = p + q/\mathrm{T}$, where T is the absolute temperature, p and q being constants whose values are 1·073 and 617·42 respectively. At 0° $\epsilon = 3{\cdot}334 \pm 0{\cdot}010$. Debye's formula: $\frac{\epsilon - 1}{\epsilon + 2} \cdot v \,.\, \mathrm{T} = \alpha \,.\, \mathrm{T} + \beta$ is found applicable to liquid bromine within the temperature range, where v is the specific volume, α and β being constants of values 0·10307 cm.^{3} gr.$^{-1}$ and 9·338 cm.^{3} gr.$^{-1}$ deg. respectively. The dipole moment of liquid bromine is $\mu = 0{\cdot}49 \times 10^{-18}$ e.s.u.

H. H. Ho.

4072. Search for Source of Dielectric Polarisation. R. D. Bennett. *Phys. Rev.* 36. *pp.* 65–70, *July* 1, 1930.

A brief discussion is given of the work of Hengstenberg [see Abstract 1547 (1930)] on the same subject. A theory of the distortion of a polar cubic lattice by electric stress is derived with the method suggested by Richardson for calculating electric stress on the ions, and the frequency of residual rays for determining the restraining forces. The effect of the distortion on intensity of X-ray reflection is then calculated in the usual manner. Measurements of change in intensity of reflected X-rays were made with a precision of about 0·1 % in the 4th and 5th orders for NaCl and the 5th order for KCl using gradients up to 700 kV/cm. It is concluded that the effect is probably not as large as predicted by Hengstenberg, *i.e.*, the polarisation is probably not due to motion of the ions as units. The precision of the experiments was not high enough to determine whether the theory derived here is correct. AUTHOR.

4073. Temperature Dependence of the Electric Moment of "Flexible" Molecules. O. Hassel and E. Nœshagen. *Zeits. f. phys. Chem.* 8. *Abt. B.* 5–6. *pp.* 357–364, *July*, 1930.

O. Werner's result [see Abstract 737 (1930)] for the rise with temperature of the moment of hydroquinone diethyl ether cannot be confirmed. In the corresponding case of the dimethyl ether, and also with such other non-rigid molecules as benzonitrile, terephthalaldehyde, benzoin and cinnamic aldehyde, no effect could be observed within the temperature range between 20° and 60° C. The method of measurement is described in detail. H. H. Ho.

4074. Electric Moments of the Stereoisomeric Stilbene Dichlorides. A. Weissberger and R. Sängewald. *Zeits. f. phys. Chem.* 9. *Abt. B.* 2. *pp.* 133–140, *July*, 1930.

Measurements have been made of the dipole moments of the two stilbene dichlorides, their molecular weights in benzene and the moment of benzyl chloride. From the difference of the moments of the stilbene dichlorides it follows that both residues cannot be freely rotatable about the methane C-C union. The preparations of the above substances, together with stilbene chlorhydrin and l-isohydrobenzoin, are discussed. H. H. Ho.

4075. Earth-Potential Observations During the Total Eclipse of the Sun on May 9, 1929. S. Nakamura and E. Hukusima. *Tohoku Imp. Univ. Sci. Reports*, 19. *pp.* 283–291, *July*, 1930. *In English.*

The writers made an observation of the earth-potential during the eclipse of the sun on May 9th, 1929, on Ituaba Island which was in the zone of totality. The eclipse began at 5 h. 47·1 m. and ended at 8 h. 32·5 m. G.M.T. on the island. Simple copper electrodes and Callender's recording potentiometers were used. The south component of potential gradient showed a rather remarkable decrease during the eclipse, but it cannot be decided whether it is due to the eclipse, or to other causes. AUTHORS.

4076. Electric Field of Overhead Thunderclouds. S. K. Banerji. *Roy. Meteorolog. Soc., J.* 56. *pp.* 305–331; *Disc.*, 331–334, *July*, 1930.

Changes in the electric field (together with other meteorological data) occurring during the passage over the Colaba Observatory (Bombay) of eighteen thunderstorms are detailed and discussed. Of these eight were "line squall" storms, forming over the Arabian Sea (mostly in March and April) and advancing eastward, and ten "heat" storms, forming over the Western Ghats (mostly in September-October) and advancing westwards. Contrary to Schonland's conclusions [see Abstracts 2119 (1927) and 1677 (1928)], it is inferred that the front part of the thundercloud is negatively charged, the centre positively charged (approximately equally), and the rear negatively (about one-third as strongly). A rough calculation gives a curve in rough agreement with the recorded potential gradient. A reasonable estimate of the charge of either sign is 50–100 coulombs. The foregoing, with the fluctuations occurring with falls of rain, supports Simpson's "breaking drop" theory. In the *Discussion*, an objection that the recording instrument was unduly sluggish was disposed of, and the value of simultaneous records of the position of the centre of the storm admitted. C. A. S.

4077. Radioelectric Recording of Very Distant Storms Over the Sahara. J. Lugeon. *Comptes Rendus,* 191. *pp.* 61–64, *July* 7, 1930.

Using photographic registration with a kathodic oscillograph and directly with a radiograph, observations were made on atmospherics simultaneously at the Oasis of El Goléa, Zurich and St. Cyr. A new type of noise heard at El Goléa similar to that of a machine-gun was detected and simultaneous traces obtained on the fluorescent screen of a Braun tube showed a new type of atmospheric. By direction bearings these were identified with storms over the central Sahara difficult to identify in other ways. The author considers the method likely to be of service for air navigation in these regions. [See Abstracts 742 and 1182 (1930).] R. S. R.

4078. Study of the Propagation of Electric Waves with the Aid of Atmospheric Wireless Parasites. R. Bureau. *Comptes Rendus,* 191. *pp.* 64–65, *July* 7, 1930.

Curves of parasitic atmospherics registered at Mt. Valerien and St. Cyr were compared for individual and mean curves. From examination of waves of different lengths, and strengths, and from different directions it is shown that while the differences are partly due to the source, account must also be taken of the general conditions of propagation and their variations, which are often very rapid. [See Abstract 1308 (1927).] R. S. R.

4079. Vertical Atmospheric Electric Current. C. Maurain, (Miss) G. Homery and G. Gibault. *Comptes Rendus,* 191. *pp.* 87–89, *July* 16, 1930.

Under the action of the atmospheric electric field the ions of the atmosphere undergo a general movement, the positive ones in the direction of the field and the negative in the reverse direction. The total flux is the vertical atmospheric electric current and has been registered continuously since 1923 at the Val-Joyeux observatory. The data are now given up to 1929 and accompanied by a brief discussion. It appears that the vertical current exhibits a maximum during summer, although of its two factors, the electric field is a maximum in winter and the conductivity in summer. H. H. Ho.

4080. Measurements of Ionisation, Electric Field and Atmospherics at Mt. Blanc. J. Lugeon. *Comptes Rendus,* 191. *pp.* 110–112, *July* 16, 1930.

Measurements were made in quiet anticyclonic weather for five days at heights of 2450, 3050 and 4358 m. and the results tabulated. The mean daily number of small positive and negative ions is the same at all heights but the geological conditions over the glacier at 2450 m. favour greater production of ions. The amplitude of daily variation of the number increases considerably with height above 2450 m. At the lowest level day and night charges are sensibly alike, but at 4358 m. the night value is three times the day value for positive and six times for negative ions. During the day the number of ions for both signs decreases with height but increases in the night. At low levels positive ions predominate day and night, but at high levels negative ions predominate at night. The variations of ionisation for the highest and lowest stations were not synchronous. Electric field variations were without relation to the ionisation for the highest and lowest stations, but some parallelism exists for simultaneous changes at the upper and middle levels. The mean potential gradient is approximately the same at the upper and middle stations but feebler at the lowest. The changes at the three levels as a cold front passes are described. The atmospherics at Vallot (4358 m.) and Mt. Blanc at sunrise and sunset show the same anomalies as in the Plain. R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

4081. Change of Electric Resistance Produced in Cold-Worked Metals by Annealing. K. Takahasi. *Tohoku Imp. Univ. Sci. Reports,* 19. *pp.* 265–282, *July,* 1930. *In English.*

The electric resistance of cold-worked metals has been found to decrease as the result of annealing them in a vacuum at comparatively low temperatures, but this resistance is generally increased by annealing them at higher temperatures. It has also been found that the resistance of copper is considerably increased by the occlusion of hydrogen gas. An explanation of these changes of electric resistance of metals caused by cold-working and annealing is here put forward. AUTHOR.

4082. Mechanism of the Spark Discharge. L. B. Loeb. *Frank. Inst., J.* 210. *pp.* 15–30, *July,* 1930.

The mechanism of the spark discharge in gases at atmospheric pressure between plane parallel electrodes is discussed in detail. It is shown that ionisation by positive ions as postulated by Townsend may be sufficient to explain sparking conditions if as a result of the dark current preceding breakdown there are space charges set up which produce fields near the kathode of sufficient magnitude. Such fields may be built up by the ionisation due to rapidly moving electrons. A detailed quantitative discussion of the implications of this theory is given. F. J. W.

4083. Mechanism of the Arc Light. Part III. Arc Discharge at Low Pressures. R. Seeliger and H. Wulfhekel. *Phys. Zeits.* 31. *pp.* 691–695, *July* 15, 1930.

Arcs were studied when struck between electrodes of plain carbon, graphite, magnetite, mixtures of carbon and copper, pure copper, aluminium and iron (both plain and oxide coated). Air, nitrogen or hydrogen at various reduced pressures surrounded the arc. The results are grouped according to whether the reduction in the size of the negative bright spot or change to glow discharge with sudden increase of voltage follows reduction of the gas pressure. Metals and iron oxide change to glow discharge, the critical pressure being in air 10 mm. and in hydrogen 100 mm. of mercury. With carbon, and carbon mixed with copper up to 30 %, the bright spot changes size. Carbon with over 70 % copper and magnetite do not show these changes. If the kathode is of high heat conductivity no arc can take place in high vacuum. The change in size of the bright spot is a quality of the surface, taking place in air, hydrogen or nitrogen but not in argon. W. C. S. P.

4084. Corona Discharge in Nitrogen. L. G. H. Huxley. *Phil. Mag.* 10. *pp.* 185–191, *July,* 1930.

Experiments on the corona discharge in specially purified helium and neon were described previously [see Abstract 1959 (1928)]. The same method is now applied to a pure diatomic gas, nitrogen, using the same apparatus. Measurements are made of the potentials between the electrodes required to start discharge and to maintain currents through the gas over a range of pressures, and the results are shown in curves. A discharge occurs more easily with the wire at a negative potential than at a positive one. Both curves have well-defined minima. The results are in agreement with Townsend's theory (*Electricity in Gases*, p. 369). T. B.

4085. Irregular Lichtenberg Figures Due to the Presence of Resistance and Inductance. T. Terada. *Kyoto Coll. Sci., Mem.* 13. *pp.* 281–290, *July*, 1930. *In English.*

A peculiar positive figure is produced by the presence of a great resistance in series with the connecting wire to the electrode, and its formation is nearly independent of the length of the spark gap and the value of the capacity in the oscillation circuit. An irregular positive figure is obtained with a suitable branched circuit, consisting of a capacity and an inductance inserted in series with the lead to the electrode. Analogous negative figures cannot be obtained under similar conditions. Both the peculiar and the irregular figures mentioned above seem to be due to successive discharges at the electrode. AUTHOR.

4086. Excitation Processes in the Hollow Kathode Discharge. R. A. Sawyer. *Phys. Rev.* 36. *pp.* 44–50, *July* 1, 1930.

From spectroscopic data it has been found that in general only those processes occur in which the metal can be excited to some term in the spark spectrum with gain or loss of only a small amount of kinetic energy to balance the reaction equation. High melting-point metals, or those which sputter poorly kathodically, enter the discharge in helium in the normal state or in a low metastable state of the atom. With low boiling-point metals, appreciable numbers of metal ions enter the reactions. In intermediate cases or in argon or neon, it is not always possible to predict if metal ions will enter the reaction or not. The conditions which determine the reaction are discussed. H. H. Ho.

4087. Excitation of Light by Low-Voltage Positive Rays. E. T. S. Appleyard. *Roy. Soc., Proc.* 128. *pp.* 330–344, *July* 1, 1930.

An account is given of experiments in which a beam of slow sodium positive ions is projected into mercury vapour. The results of Tate [*Phys. Rev.* 23. pp. 293–294, February (1924)] are confirmed. The greater part of the sodium light is emitted by recapture of an electron from a mercury atom into some excited state of the sodium atom. An approximate efficiency-voltage curve for the line groups λ(4358, 4347) and λ(3650, 3655, 3663) of mercury has been obtained and compared with the efficiency-voltage curve for electrons. [See also Abstract 2636 (1930)]. F. J. W.

4088. Concentration of Beams of Slow Electrons. I. Ranzi. *N. Cimento*, 7. *pp.* 254–259, *June*, 1930.

Shows that the experiment of Thibaud [see Abstract 3632 (1929)] on a beam of slow electrons traversing a magnetic field axially and undergoing a thread-like concentration with several maxima, can be explained otherwise than as due to the magnetic moment of the electrons. The author explains it as due to the presence of positive ions in the beam, and shows that a certain time is necessary to produce the ionisation required for the maintenance of the threadlike state. E. E. F. d'A.

4089. Distribution of Electric Forces in Spaces Traversed by Electrons. E. W. B. Gill. *Phil. Mag.* 10. *pp.* 134–139, *July*, 1930.

Different recent investigators, who have made use of a stream of electrons moving between two grids or electrodes kept at the same potential, have assumed that the electric force in the space between the electrode was zero or negligible. The author shows that for plane parallel electrodes, with electrons moving at right angles to them in a vacuum, or through a gas at such low pressure that collisions are rare, the electric field due to the distribution of the electrons can be calculated in a manner similar to that employed in the theory of Langmuir and Child. The equipotential surfaces are planes parallel to the grids if the areas of these are large compared with the distance between them, and the potential drops to a minimum on the plane midway between the two grids. Both of these are at the same potential V with respect to the incandescent filament from which the electrons proceed. In actual experiments the calculations are not as simple as in the above case, but the general conclusion can be drawn that the velocities of electrons traversing force-free spaces are generally less than the velocities with which they are projected through the first grid. H. N. A.

4090. Behaviour of Electrons Amongst the Molecules NH_3, H_2O and HCl. V. A. Bailey and W. E. Duncanson. *Phil. Mag.* 10. *pp.* 145–160, *July*, 1930.

Uses the new method, recently described by Bailey [see Abstract 3230 (1930)]; it is applicable to conditions where ionisation by collision is absent, and where the negative ions are permanent; and makes it possible to determine the statistical behaviour of electrons amongst molecules to which they may become attached. The application to the above gases is described in detail, and consistent results are obtained for the energy of agitation of electrons, velocity of drift and probability of attachment to molecules per unit distance of drift. From these the mean free path of an electron, the fraction λ of its own energy which is lost, and the probability h of its being attached to a molecule when it collides with it have been deduced. Apparently λ bears some relation to the light-absorbing power of the molecule, and h generally increases with the penetration of the electron into the molecule. H. N. A.

4091. Cross-Section Measurements of Non-Inert Gas Molecules by Slow Electrons. H. L. Bröse and E. H. Saayman. *Ann. d. Physik,* 5. 7. *pp.* 797–852. *July* 16, 1930.

This very comprehensive paper deals with the subject-matter in the following sections: Townsend diffusion methods for the measurement of orbit velocity (thermal velocity) and for the propagation velocity of electrons in gases; calculation of the mean free path of electrons in gases and discussion of Townsend's definition; description of apparatus and of the preparation and purification procedure of the materials employed in the present investigation; discussion of the limitations and scope of the methods now used with appropriate examples; results for the non-inert gases, hydrogen, nitrogen, carbon monoxide, pentane, oxygen, ethylene carbon dioxide and nitrous oxide, and comparison with existing data; historical survey of previous work; mathematical appendix to the subject; and finally an exhaustive bibliography. H. H. Ho.

4092. Decomposition of the Effective Cross-Section. R. Kollath. *Ann. d. Physik,* 5. 8. *pp.* 1017–1040, *July* 26, 1930.

The effective cross-section which measures the proportion of electrons in

a homogeneous beam of given velocity which are acted upon in any way by passage through a particular gas, results from three effects: (*a*) deflection without loss of velocity; (*b*) partial loss of velocity; (*c*) absorption or reduction of velocity to practically zero. For nitrogen the curve effective cross-section against electron beam velocity shows a sharp maximum at an electron velocity of $1\cdot7\sqrt{\text{volts}}$ and a flat maximum at $4\cdot2\sqrt{\text{volts}}$. The proportion of electrons deflected through 90° without loss of velocity shows a single maximum at $1\cdot7\sqrt{\text{volts}}$. The present experiments show that absorption of electrons can contribute nothing to the first maximum at $1\cdot7\sqrt{\text{volts}}$, and can only play a subsidiary part in the production of the second maximum. Other measurements of the electrons deflected through 90° with partial loss of velocity show that effect (*b*) probably explains the second maximum, but is not concerned in the first maximum, which must therefore be due entirely to electrons deflected without loss of velocity. The second maximum coincides with the appearance of electrons which have lost the energy necessary to ionise the nitrogen molecule.
W. S. S.

4093. Computation of Effective Cross-Section for Recombination of Electrons with Hydrogen Ions. E. C. G. Stueckelberg and P. M. Morse. *Phys. Rev.* 36. *pp.* 16–23, *July* 1, 1930.

The quantum-mechanical computation of the cross-section for combination of electrons with a positive point charge has been carried out in polar coordinates. This gives the fraction of the recombination to a final state of total quantum number n arising from recombination to the substates of different l values, making possible a comparison of the results with the experimental recombination intensities for alkali vapours to which the theory applies approximately. AUTHORS.

4094. Recombination of Ions in Argon, Nitrogen and Hydrogen. O. Luhr. *Phys. Rev.* 36. *pp.* 24–34, *July* 1, 1930.

These gases were investigated because free electrons are known to exist in them. It was hoped to measure directly the coefficient of recombination for positive ions and electrons. The coefficient for positive and negative ions in hydrogen is theoretically different from that in other gases. The experiments indicate that recombination took place in these gases between positive and negative ions rather than between positive ions and electrons. The values for a found are for $A(1\cdot2 \pm 0\cdot1) \times 10^{-6}$, for $N_2(1\cdot2 \pm 1) \times 10^{-6}$, for H_2 $(0\cdot32 \pm 0\cdot05) \times 10^{-6}$. The low value for H_2 is contrary to the theory of J. J. Thomson, as modified by Loeb and Marshall, but the theory is deficient in certain respects. H. N. A.

4095. Mobilities of Ions in Dry and Moist Air. J. Zeleny. *Phys. Rev.* 36. *pp.* 35–43, *July* 1, 1930.

A neglected correction in previous results [see Abstract 306 (1930)] has entailed the redetermination of the mobilities of ions in moist air and this has now been supplemented by the evaluation of the distribution of mobilities of aged ions in dry air. In air, dried by passage through metal tubes and filters immersed in liquid air, the negative ions consisted of two main groups, the number of ions in the lesser group being relatively smaller in air dried by calcium chloride alone; their presence in still smaller numbers in air having a water content of 2 mg. per litre accounts for the dissymmetry in the distribution curves. There are also indications of two groups of ions in dry air. The absolute values of the peak mobilities found for the main group of negative ions in the driest air used at 20° C. and 760 mm. was 2·45 cm./sec. and diminished to 2·37 cm./sec. for air dried with calcium chloride and to 2·08 cm./sec. for air with 2 mg. water per litre. Under the same conditions the mobilities of the positive ions increased in succession from 1·05 cm./sec. to 1·10 and to 1·36. These large opposite changes produced by a small fraction of water molecules can only be explained on the supposition that aged ions in air consist of molecular clusters whose structure is affected by the presence of water molecules. The second group of negative ions cannot consist of ions having multiple electronic charges, because the mobility of these ions is smaller than that of the main ion group, and the central molecule is probably an oxygen molecule. H. H. Ho.

4096. Second Ionisation Potential in Potassium Vapour. A. L. Hughes and C. M. van Atta. *Phys. Rev.* 36. *pp.* 214–218, *July* 15, 1930.

The occurrence of a second peak in the photoionisation curve of potassium vapour (Lawrence and Edlefsen) [see Abstract 1174 (1930)] suggests that there might be a related peak (or discontinuity) in the curve for ionisation by electron impact. The ionisation in potassium vapour was investigated by Hertz's method of neutralisation of space charge by positive ions. It was found that there was an abrupt increase in gradient of the ionisation curve, indicating a second ionisation potential at 0·97 ± 0·05 volt above the first one corresponding to the series limit. With mercury vapour, the apparatus indicated the presence of Lawrence's ultraionisation potentials in mercury vapour, together with three new ones (10·40, 10·62, 10·88, 11·28, 11·40, 11·77, 12·16, 12·46). AUTHORS.

4097. Effect of Small Angle Scattering on Electron Absorption Coefficient. Metta C. Green. *Phys. Rev.* 36. *pp.* 239–247, *July* 15, 1930.

An indirect study of the scattering of electrons by gas molecules has been made by measuring electron absorption coefficients in an apparatus containing a Faraday cylinder of variable aperture. A straight-path method was used in which electrons from an oxide-coated filament were given a desired velocity and made to traverse a 7·5 cm. path to the collector. A retarding potential between the cylinder and its shield kept out all electrons which had suffered inelastic collisions as well as those which had been scattered outside of the collector opening. Measurements were made in argon, helium, hydrogen, and mercury vapour at accelerating potentials ranging from 11 to 196 volts. The radius of the cylinder aperture varied from 0·01 to 0·1 of the path length. No consistent variation of the absorption coefficient with opening was found in any case. Theoretical calculations based on scattering laws obtained from inverse square or fifth power laws of force predicted relatively large variations. Calculations made assuming uniform scattering or the Sommerfeld law indicated small changes of the same order of magnitude as the deviations between individual values obtained in this experiment. AUTHOR.

4098. Rate of Energy Loss of Ions in Elastic Collisions. A. M. Cravath. *Phys. Rev.* 36. *pp.* 248–250, *July* 15, 1930.

The rate of energy loss of ions (including electrons) moving through a gas is rigorously calculated on the assumption that the ions and molecules are smooth elastic spheres with no attraction at a distance, having Maxwellian velocity distributions corresponding to the temperatures T_i and T_m

respectively. The result is $f = \frac{8}{3}\frac{mM}{(m + M)^2}\left(1 - \frac{T_m}{T_i}\right)$, where m and M are the masses of ion and molecule respectively, T_i and T_m are their temperatures, and f is the average energy loss per collision expressed as a fraction of the average ionic energy. AUTHOR.

4099. Sensitiveness of Photoelectric Cells. A. R. Olpin. *Phys. Rev.* 36. *pp.* 251–295, *July* 15, 1930.

The marked increase in electron emission produced by introducing on to the metal surface small amounts of certain dielectrics or organic compounds is due primarily to an increase in response to red and infra-red light. Vacuum sodium cells have been produced yielding photoelectric currents as high as 7 microamperes per lumen of white light of colour temperature 2848° K, and cæsium cells yielding far greater currents. E. E. F. d'A.

4100. Photoelectric Cell as Measuring Instrument. R. Sewig. *Zeits. f. Instrumentenk.* 50. *pp.* 426–438, *July*, 1930.

The author gives a description of various types of photoelectric cell—vacuum and gas-filled cells, cells with monomolecular layer kathodes, etc.—and discusses their constancy, reproducibility, liability to fatigue, and sensitivity, with special reference to their use in the measurement of light intensities. A brief account of the various electric circuits including those using thermionic amplification, which are applied in measuring the response of photoelectric cells, is also given. A concluding section enumerates the principal application of photoelectric cells as measuring instruments. W. S. S.

4101. Photoionisation of Cæsium by Line-Absorption. F. L. Mohler and C. Boeckner. *Bureau of Standards, J. of Research.* 5. *pp.* 51–71, *July*, 1930.

Cæsium can be ionised not only by light beyond the series limit, but also by light of the frequency of certain lines of the principal series. This effect has been studied, chiefly with reference to the problem of the source of the additional energy necessary to account for the ionisation. The method used consists in allowing light resolved by a monochromator to fall on the vapour, and comparing the ionisation with that observed in the continuous spectrum beyond the series limit. The effective width of an absorption line is about 0·007 Å. at 0·003 mm. pressure. The explanation favoured by the authors is one due to Franck, that ionisation results from the combination of excited and normal atoms to form molecule ions. J. H. A.

4102. Characteristic Velocity of the Electrons Diffused from Metallic Surfaces. G. Bernardini. *Accad. Lincei, Atti*, 11. *pp.* 1096–1099, *June* 15, 1930.

A preliminary account is given of experiments with the diffused electrons which have undergone small loss of velocity when a metallic surface is bombarded with primary electrons. From observations on the magnetic spectra obtained, which were photographed, discontinuities are shown which seem to give evidence of characteristic losses of velocity in the primary electrons. J. J. S.

4103. Theory of the Extraction of Electrons from Metals by Positive Ions and Metastable Atoms. H. S. W. Massey. *Cambridge Phil. Soc., Proc.* 26. *pp.* 386–401, *July*, 1930.

The theory of the effect is treated in the light of the Sommerfeld theory of metals and the analytic methods of wave mechanics, and the conclusion is drawn that the mechanism assumed is adequate to account for the neutralisation of positive ions and the emission of electrons by metastable atoms. J. J. S.

4104. Magnetic Properties and Crystal Lattice of Ferrites. S. Holgersson and (Miss) A. Serres. *Comptes Rendus*, 191. *pp.* 35–37, *July* 7, 1930.

The ferrites of magnesium, lead, copper and nickel have previously been found to have similar magnetic properties, being ferromagnetic at ordinary temperatures; the properties of zinc ferrite are quite different, and it is not ferromagnetic at ordinary temperatures, nor even at that of liquid air. The authors have examined these substances by the X-ray method, and find that they all have the same lattice structure, that of spinel, with almost constant parameters, that of the zinc compound lying between those of magnesium and of copper. Cadmium ferrite has also been investigated; at ordinary temperatures it is sometimes ferromagnetic and sometimes paramagnetic. In the two states its other magnetic properties were different. It appears that the magnetic properties of the atom of ferric iron Fe‴ depend to some extent on the nature of the neighbouring atoms in the crystal lattice. H. N. A.

4105. Ferromagnetic Fe_2O_3 as a Model for the Heisenberg Theory of Ferromagnetism. H. Sachse. *Zeits. f. phys. Chem.* 9. *Abt. B.* 1. *pp.* 83–91, *July*, 1930.

Heisenberg has shown that theoretically an increase in the number of neighbours in the lattice is favourable to the appearance of ferromagnetism. Considers the structure of regular ferromagnetic Fe_2O_3, and of trigonal paramagnetic Fe_2O_3 (hæmatite), and concludes that the number of near neighbours for the iron atoms is much greater in the first case than in the second. Notes that the fact that regular Fe_2O_3 is ferromagnetic tends to negative the theory of Dorfman and Jaanus, who consider ferromagnetism as depending on the spin moment of free (electric conductivity) electrons, while Heisenberg considers the mutual actions between bound electrons. Most ferromagnetic substances are good conductors, but Fe_2O_3 has 10^{10} times as small a conductivity as Fe, Co or Ni, and it does not seem probable that free electrons can be concerned in its magnetic properties. [See also Abstract 3847 (1930).] H. N. A.

4106. Free Electrons and Ferromagnetism. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 50–55, *April*, 1930.

If ferromagnetism were due to free electrons, the Curie temperature θ would have a value depending on the saturation intensity of magnetism which for nickel would be $\theta > 43{,}160°$ (observed value 640°), with correspondingly large values for other ferromagnetics. It is concluded that ferromagnetism is not due to free electrons but to interchange interaction electrons as in Heisenberg's theory. G. E. A.

4107. Interchange Interaction Theory of Ferromagnetism. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 56–60, *April*, 1930.

Considering the atoms in a crystal as separate systems interacting with neighbouring atoms, a very simple treatment of the interchange interaction theory of ferromagnetism is given which is different in point of method from that of Heisenberg. The expressions for the magnetisation energy are formally equivalent to those given by the Weiss theory, and there is very satisfactory agreement between theory and observation.

G. E. A.

4108. Magnetic and Magneto-Thermal Properties of Ferromagnetics. E. C. Stoner. *Phil. Mag.* 10. *pp.* 27–48, *July*, 1930.

Formulæ for the variation of magnetisation with field and temperature are derived, using the quantum modification of Weiss's theory. Expressions for the change in specific heat at the Curie point are also given. The Heisenberg interchange-interaction theory is discussed; it leads to a satisfactory interpretation of the molecular field, but its results for variation of spontaneous magnetisation with temperature and for change of specific heat do not agree with experiment. The gyromagnetic ratio and variation of magnetisation with temperature indicate that in ferromagnetics magnetisation is due to the change of orientation of electrons. The saturation value and the change in specific heat lead to the same number of effective electrons per atom. This number varies little up to the Curie point. G. E. A.

4109. Diamagnetism and Sub-Molecular Structure. F. W. Gray and J. Farquharson. *Phil. Mag.* 10. *pp.* 191–216, *July*, 1930.

Van Vleck and Pauling have, separately, found an expression for the diamagnetic susceptibility of a gram atom which gives an upper limit not reached by experimentally obtained values. The relation of diamagnetism to two kinds of bonds is discussed, *viz.*, covalency and electrovalency bonds. Further, the idea of a "merger atom" is employed in considering the diamagnetic changes which are brought about by the coming closer together of the widely separated ions of a neutral group, first to form a molecule, and afterwards by an imaginary forced merging of the ionic nuclei to form a single "merger atom." After the formation of the molecule, all the atomic diamagnetisms are subject to a depression. This depression is investigated, being due in part to fluctuations of angular momentum. G. E. A.

4110. Gyromagnetic Effect for Paramagnetic Substances. W. Sucksmith. *Roy. Soc., Proc.* 128. *pp.* 276–293, *July* 1, 1930.

A method of measuring the gyromagnetic ratio for paramagnetic substances is described. Hitherto measurements have been made only on various ferromagnetic materials, which show that the source of magnetic moment is entirely due to the spin of the electron. For paramagnetic bodies the angular momentum produced by a change in magnetic moment is very small, and low frequency resonance was used to build up the resulting impulse to a measurable magnitude. If the paramagnetic ion is free the value of the gyromagnetic ratio involves g, the Landé splitting factor. The value $g = 1 \cdot 28 \pm 0 \cdot 07$ was found for the Dy^{+++} ion in dysprosium oxide, which indicates that the magnetic moment is composed of both orbital and spin contributions. This agrees with the theoretical value 4/3, which corresponds to the $^6H_{15/2}$ state deduced by Hund as being the most probable for this ion. J. J. S.

4111. Magnetism and Molecular Structure. Part I. Magnetic Susceptibilities of Some Liquid Organic Isomers. S. S. Bhatnagar, R. N. Mathur and R. S. Mal. *Phil. Mag.* 10. *pp.* 101–109, *July*, 1930.

A U-tube apparatus similar to that of Bauer and Piccard was employed, which had a water jacket to keep the temperature constant. The rise or fall of the meniscus when the magnetic field was applied was observed with a microscope. The values of the molecular magnetic susceptibility, χ_M, for aliphatic isomerides were observed to increase in the order primary, secondary, tertiary; the difference between tertiary and secondary being much less than between secondary and primary. In aromatic isomerides, χ_M for the orthoisomerides is a maximum, the values for meta and para are close together. In every group the isomeride with a large value of the molecular magnetic rotation has also a large χ_M. The isomeride with higher boiling point has a lower value for χ_M. In the alcohols the isomeride with larger molecular volume has larger χ_M; with aromatic isomerides, when the ortho has the largest χ_M, it has the smallest molecular volume. In the cases tested, in a group of isomerides the more anisotropic the molecule the smaller is χ_M. H. N. A.

4112. Existence of Electronic Isomers in the Solid State and in Solution. Magnetic Susceptibility of $Sm_2(SO_4)_3 8H_2O$ and Its Variation with the Temperature. S. Freed. *Am. Chem. Soc., J.* 52. *pp.* 2702–2712, *July*, 1930.

The magnetic susceptibility of $Sm_2(SO_4)_3 . 8H_2O$ has been measured from 73·8 to 290·6° K. by a new method, details of which are given. It was found that Sm^{+++}, both in the solid state and in solution, consists of a mixture of electronic isomers which appear to be in thermal equilibrium. The variation of the susceptibility with the temperature [see Abstract 1986 (1928)] suggests that the isomer stable at the lowest temperature has the electronic configuration:

Sm^{+++}	1_1	2_1 to 4_3	4_4	5_1	5_2	electronic shell
	2	full	5	2	6	number of electrons.

The conclusion that Sm^{+++} consists of a mixture of electronic isomers varying in concentration with the temperature carried with it the prediction that its absorption spectrum would consist of lines whose relative intensities would vary with the temperature. Such a variation was found by Freed and Spedding [*Nature*, 123. pp. 525–526, April 6 (1929)] in the case of $SmCl_3 . 6H_2O$ taken from room-temperature to that of liquid hydrogen. H. H. Ho.

4113. Principal Magnetic Susceptibilities of Bismuth Single Crystals. A. B. Focke. *Phys. Rev.* 36. *pp.* 319–325, *July* 15, 1930.

The Gouy method is used to determine the principal magnetic susceptibilities of bismuth single crystals grown by the method developed by Goetz [see Abstract 2338 (1930)]. The specific susceptibility is shown to be a constant in all directions perpendicular to the principal crystallographic axis with a value of $-1·487 \times 10^{-6}$. Parallel to the main axis the specific susceptibility is a minimum and has the value $-1·046 \times 10^{-6}$. The mean is given then as $-1·340 \times 10^{-6}$. AUTHOR.

4114. Discontinuous Changes in Length Accompanying the Barkhausen Effect in Nickel. C. W. Heaps and A. B. Bryan. *Phys. Rev.* 36. *pp.* 326–332, *July* 15, 1930.

A heterodyne beat method is described by means of which displacements as small as 9×10^{-9} cm. may be measured. When a nickel wire, 1·96 cm. long and 0·01 cm. in diameter, is subjected to a steadily changing magnetic field there is evidence of a sudden length change at the instant of a Barkhausen discontinuity of magnetisation. For a nickel wire 2 cm. long and 0·002 cm. in diameter these sudden length changes were larger and could easily be measured. They were associated with every Barkhausen jump observed in the specimen. The largest one measured was $4 \cdot 7 \times 10^{-7}$ cm. Calculations based on the measurements of these magnetostrictive jumps give $3 \cdot 7 \times 10^{-7}$ cc. for the minimum value of the volume of the element which suffers the jumps. Reasons are advanced for believing that the sudden change in intensity of magnetisation of this volume element cannot be less than 40 units nor more than 330. A qualitative theory of the phenomenon is given. AUTHORS.

4115. Some Fundamental Theorems of Electrodynamics and of the Statics of Elastic Solids. D. Bonvicini. *Accad. Lincei, Atti*, 11. *pp.* 974–979, *May* 30, 1930.

A mathematical discussion is given of the analogy between the theory of the distribution of the electric current in its permanent *régime* in a conductor of any form whatever and some theorems of the statics of elastic solids. J. J. S.

4116. Mutual Inductance of Short Concentric Solenoids. H. B. Dwight and P. W. Sayles. *J. Math. Phys., Mass. Inst. of Technology*, 9. *pp.* 162–165, *July*, 1930.

It has been found that a series formula containing log terms is very rapidly convergent for mutual inductance of short solenoids close together. Such a formula has been derived and is given in this paper. It is shown that for very short solenoids near together the other series formulæ, with which comparison is made are not rapidly enough convergent for practical numerical calculations. A measurement of the mutual inductance of two concentric solenoids of equal length was made. The length of the solenoids was 4·29 cm. The smaller coil had 95 turns and a mean diameter of 7·68 cm. The larger one had 91 turns and a mean diameter of 11·20 cm. The measured mutual inductance was 0·437 millihenry and the calculated value 0·450 millihenry. J. J. S.

4117. Mechanical Action of Electromagnetic Waves on a Conductor. Suzanne Husson. *Comptes Rendus*, 191. *pp.* 33–35, *July* 7, 1930.

Describes experiments in which a light, straight resonating conductor, the length of which is half the wave-length of the electromagnetic waves, is hung parallel to the electric vector, being suspended in a light frame, provided with a minute mirror, by a quartz fibre, and enclosed in a tube from which the air has been exhausted. Derives an expression for the total mean force acting on the conductor. This force corresponds to a radiation pressure. Describes how the force can be augmented by means of a metal plate acting as a mirror for the electromagnetic waves, and placed at the proper distance from the oscillator. If the mirror is shifted, positions are found where the effect of the reflected waves interferes with that of the direct waves from the oscillator, and intermediate positions where the two sets of waves add their effects. H. N. A.

APPARATUS AND INSTRUMENTS.

4118. Wide-Range Portable Capacity Test Set. W. H. F. Griffiths. *Journ. Sci. Instruments*, 7. *pp.* 199–203, *June*, 1930.

An account of a portable set which has a range of 0·00003 μF to 1·0 μF on a single rotary scale, without multiplying devices or range extensions. The percentage accuracy may be made of constant order throughout the entire range of the instrument, but in the first model constructed the scale-reading accuracy was 2 % from 0·0002 μF to 0·2 μF; but at the extreme ends of the scale corresponding to higher or lower capacities than this the measurements may be made to 5 or perhaps 10 %. The set is a simple four-capacity arm bridge with supply buzzer and battery and standard condensers, all contained in a box approximately 8 × 7 × 8 in. Continuously variable capacity ratio arms are employed, taking the form of a differential variable air condenser, or ordinary variable air condensers operated differentially, both of which must obey an approximately linear relationship between capacity and angular displacement. The scale-reading will give the value of the unknown capacity in terms of the ratio arms and a known fixed capacity, the value of which is 1000 $\mu\mu$F for values of the unknown capacity up to 6000 $\mu\mu$F. For measuring capacities beyond this value up to 1 μF, rotation of the dial automatically increases the value of the fixed condenser so as to give a new set of scale-readings, corresponding to this change. W. C. S. P.

4119. Portable Standard Compass. T. F. Connolly. *Journ. Sci. Instruments*, 7. *pp.* 211–216, *July*, 1930.

The compass described consists essentially of a magnetic and an associated sighting system which are freely swung together on a point and jewel support. The sighting system actually used is a telescope on the inside walls of which a number of magnets are secured. The telescope is supported on open V's so that it can be rotated in its optical axis through 180°. The mean of two observations, after oscillations to rest, gives a magnetic alignment which is accurate to ± 1′ of arc. AUTHOR.

4120. Distant Determination of Galvanometer Zero. D. S. Perfect and J. Guild. *Journ. Sci. Instruments*, 7. *pp.* 222–225, *July*, 1930.

A method is described by which the position of the zero of a galvanometer can be determined at a distance. A precision equivalent to a fraction of 1 mm. at 2 m. is easily attainable, and the fatigue of working is less than in the usual method of reading a scale. The method is applicable where a straight optical path between the galvanometer and observer is not available. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

4121. Output of a Transformer with Different Methods of Rectification of the H.T. Current. A. Orliansky. *Brit. J. of Radiology*, 3. *pp.* 316–319, *July*, 1930.

Deals with comparative measurements of the output of a transformer with single-valve, self-rectifying, X-ray tube, 4-valve and mechanical rectification. The author finds the ionometric results are in favour of valve rectification as opposed to mechanical rectification, and that single-valve rectification is more efficient than 4-valve rectification. Radiographic results showed better film contrast in the case of mechanical rectification. The author states that being unable to investigate the current form, and only using one type of mechanical rectifier, his results are not conclusive. No data are given as regards spectrographic distribution. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

4122. Adsorption of Methyl Alcohol Films on Rock-Salt. S. Silverman. *Phys. Rev.* 36. *pp.* 311–318, *July* 15, 1930.

The optical method of Rayleigh and Drude as recently modified by Frazer and Herzfeld has been applied to the study of methyl-alcohol films on rock-salt. The isothermal adsorption has been studied at pressures ranging from 10^{-5} mm. to 11 cm. mercury. The results indicate that a unimolecular layer is formed at a pressure between 10^{-5} and 10^{-4} mm. of mercury, with no further adsorption until the region of 2–3 cm., when a second layer begins to form, with completion at 9–10 cm. The thickness of these layers is calculated to be in the neighbourhood of 4·5–5·0 Å. The effect of thorough outgassing has been observed and the results have been interpreted to indicate that with decrease in temperature either an underlying unimolecular layer of water vapour is formed, or that there is a true increase in the natural ellipticity of the surface. In addition, it is possible to calculate the isothermal heat of adsorption from the experimental data. AUTHOR.

4123. Filtration Through Layers. Theory of the Gas Mask. W. Mecklenburg. *Kolloid Zeits.* 52. *pp.* 88–103, *July*, 1930.

The results of Schilow, Lepin and Wosnessensky [Abstract 1624 (1930)] relating to the effects of variations in length of carbon layer, velocity of air stream, concentration of chlorine and grain-size of carbon on the adsorption of chlorine from a stream of air by activated carbon are consistent with the "Aussig" theory of the gas mask. A. J. M.

4124. Boundary Potential and Reactions at Surfaces. Part I. Reduction of Permanganate by Carbon. A. Wassermann. *Zeits. f. phys. Chem.* 149. *Abt. A.* 3. *pp.* 223–239, *July*, 1930.

The mechanism of the reduction of dilute solutions of $KMnO_4$ by powdered carbon at room-temperature is investigated. Assuming that the diffusion of MnO_4^- ions to the phase boundary determines the rate of reduction of the $KMnO_4$, the charge on the surface of the carbon should influence the rate. The variations of the time-conversion curves with the *p*H of acid solutions are in agreement with this assumption. In alkaline solutions the rate of reduction is approximately the same whether normal or activated sugar carbon is used, both types of carbon being negatively charged. In acid solutions the positively charged activated carbon is much more effective than the negatively charged normal carbon. The reaction time in alkaline solutions is independent of the concentration of alkali, probably on account of the small adsorption of OH^- ions on carbon. A. J. M.

4125. Solubility of Silver Chloride, Bromide and Iodide in Methyl and Ethyl Alcohols. F. K. V. Koch. *Chem. Soc., J. pp.* 1551–1558, *July*, 1930.

The solubilities of silver chloride, bromide and iodide in methyl, and ethyl alcohols were determined by an electrochemical method. The results obtained were in disagreement with the Walden relation, which required that the solubility should be proportional to the cube of the dielectric constant of the solvent. Distribution coefficients of the three halogen ions were calculated for the solvent pairs, water-methyl alcohol, water-ethyl alcohol, and the normal potentials were deduced. Born's formula yielded results which were in good agreement with the experimental results for the differences in normal potential of chlorine, bromine, iodine and silver for pairs of the solvents. F. J. B.

4126. Solutions for Colorimetric Standards. Part III. M. G. Mellon and Violet Foster. *J. Phys. Chem.* 34. *pp.* 963–972, *May*, 1930.

The hue of solutions of inorganic substances in organic and inorganic solvents and the question of the permanency of the colours is investigated. Salts of nickel, copper, cobalt, iron and solutions of iodine are used. The solvents employed are ethyl alcohol, *n*-propyl alcohol, *n*-butyl alcohol, glycol, ethyl acetate, *n*-butyl acetate, chloroform, carbon tetrachloride, ethyl bromide, carbon bisulphide, ethylene dichloride and pyridene. Water acidified with HCl, and water rendered alkaline with ammonium hydrate, sulphuric, phosphoric, chloric and acetic acids are also used as solvents. The effects of laboratory light and of ultra-violet radiation, and sunlight are investigated for each solution in the various solvents. Sunlight is found to exert the most effect on the hue of the solutions.

F. J. B.

4127. Phase Diagram for Unimolecular Films. C. G. Lyons and E. K. Rideal. *Cambridge Phil. Soc., Proc.* 26. *pp.* 419–420, *July*, 1930.

According to recent views [see Abstract 3223 (1929)] the solid condensed, liquid condensed, expanded and vaporous types of unimolecular films on the surface of aqueous solutions are the two-dimensional analogues of the solid, liquid crystal or smectic, liquid and vapour states of bulk matter. The previously unsuspected observation that the films show triple point phenomena supports these conclusions. Pressure-temperature curves for a substance giving liquid crystals in a three-dimensional system are now shown and curves drawn from them in which the phases are replaced by their two-dimensional analogues, thereby showing the exact analogy between the two- and three-dimensional systems. H. H. Ho.

4128. Orientation of Fatty Acids in Contact with a Liquid Phase. J. J. Trillat and A. Nowakowski. *Comptes Rendus*, 191. *pp.* 203–205, *July* 28, 1930.

The method previously used by the author [see Abstract 2359 (1929)] has now been applied to the study of the equilibrium of a solid film of acid and its liquid form and the orientation of a fatty acid in contact with water, mineral acid (HCl), organic acid (acetic) and soda. Stearic, palmitic and lauric acids were employed. H. H. Ho.

4129. Mercury as Dispersing Medium. Colloidal Nature of Iron Amalgams. M. Rabinowitsch and P. B. Zywotinski. *Kolloid Zeits.* 52. *pp.* 31–37, *July*, 1930.

Iron is difficult to amalgamate and hardly soluble in mercury. The amalgam behaves like a suspension, and the iron can be filtered out or removed by magnets. The authors obtain an iron amalgam containing $3 \cdot 6 \times 10^{-3}$ parts of iron to 1 part of mercury (in gm.-atoms) by electrolysis of mercurous nitrate in nitric acid. The iron rises to the top; this is studied in tubes of 5 mm. diam. This rise, which is more rapid at higher temperature, is accompanied by an increase in the particle size

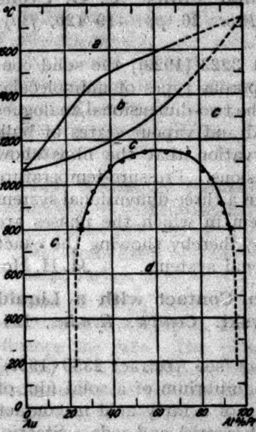
and is accelerated, from an hour or so to a few minutes, by the presence of other amalgams, especially tin and zinc. The rise or reversed sedimentation leaves a paste of an amalgam gel at the top; the gel squeezes out mercury (synæresis). The iron amalgam is colloidal, and the disperse phase (mercury) is not a dielectron, so that double layers are not formed.
H. B.

4130. Equilibrium Diagram of Lead-Tin System. K. Honda and H. Abé. *Tohoku Univ. Sci. Reports*, 19. *pp*. 315–330, *July*, 1930. *In English.*

The equilibrium diagram of the lead-tin system has been studied by differential thermal analysis. It was confirmed that the heat evolution occurring at about 160° just below the eutectic point is due to a rapid decrease in solubility of the β phase in the α solid solution, with the fall of temperature. Thus the equilibrium diagram of the system was greatly simplified by omitting a horizontal line at about 160°. AUTHORS.

4131. Physical Properties, Temper-Hardening and Constitution of Gold-Platinum Alloys. C. H. Johansson and J. O. Linde. *Ann. d. Physik*, 5. 6. *pp*. 762–792, *July* 7, 1930.

A thermal equilibrium diagram for the gold-platinum alloys is derived from determinations of crystal structure, electrical resistance, thermo-electric force, thermal conductivity, magnetic susceptibility and hardness, after various types of heat-treatment. Immediately below the solidus the alloys form a continuous series of solid solutions, but at 400° C. there is a two-phase field extending from 23 to 96 % Pt. The mutual solid solubility increases with rise of temperature until complete miscibility is attained at 1150° C. The Brinell hardness of an alloy containing 40 % Pt quenched from 1175° C. is more than doubled by tempering for 120 hours at 400° C. Certain anomalous results in the X-ray analysis are compared with analogous observations in the copper-gold, copper-palladium and copper-zinc systems. The estimation of solid solubility limits at low temperatures from measurements of electrical conductivity is discussed. A. J. M.



4132. Alloys of the Ternary System, Iron-Nickel-Cobalt. H. Kühlewein. *Phys. Zeits.* 31. *pp*. 626–640, *July* 1, 1930.

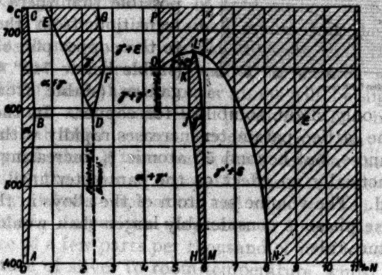
A survey of physical and mechanical properties of Fe, Ni and Co and their alloys, with an extensive Bibliography of recent work.

4133. X-Ray Study of the Nitrides of Iron. G. Hägg. *Zeits. f. phys. Chem.* 8. *Abt. B.* 5–6. *pp*. 455–474, *July*, 1930.

The nitrides are prepared as in the case of manganese [see Abstract 50 (1930)], by reducing iron oxide with hydrogen and passing ammonia over it, mostly between 350 and 550° C. There is no change of phase then, although thermodynamical equilibrium is not attained frequently. Azotation at higher temperatures is difficult and only possible in a rapid stream of ammonia, because the nitrides are decomposed again. Powder radiograms are taken. Above 600° nitrogen dissolves in α-iron under extension of the lattice to 2·871 Å. Iron with 1·5 to 2 % of N by weight, quenched from 725°, consists essentially of solutions of N in γ-iron of maximum edge dimension 3·638 Å. Below 600° there is a narrow homogeneous area of γ_1 iron, approximately Fe_4N, cubic face-centred as before, but up to 3·79 Å. Between 8 and 11 atomic % of N there is another iron phase ϵ in a close hexagonal lattice with axis c varying from 4·362 to 4·717 Å. Beyond that ζ-iron in a rhombic lattice, $c = 4{\cdot}419$ Å.; this base-centred lattice resembles that of the ϵ phase. The nitride with least nitrogen is Fe_2N. Some of these observations agree with Fry (1923); reference is also made to S. Epstein (1929) and Osawa and Iwaigumi [see Abstract 2916 (1929)]. H. B.

4134. Magnetic Investigation of the Iron-Nitrogen System. E. Lehrer. *Zeits. f. Elektrochem.* 36. *pp.* 460–473, *July*, 1930.

A thermal equilibrium diagram for the iron-nitrogen system from 0 to 11 % nitrogen and 400° to 720° C. is deduced from magnetic observa-



tions [see Abstract 3165 (1929)], together with chemical and X-ray analysis on heat-treated specimens, prepared by nitriding iron. The diagram shows four-phase fields, with two eutectoids at 591 ± 4° C. (2·35 ± 0·1 % nitrogen) and 650 ± 4° C. (4·55 ± 0·2 % nitrogen). Microstructures previously reported are explained on the basis of this diagram. A. J. M.

4135. The Metal Crystal. H. Carpenter. *Roy. Inst., Proc. Advance Proof.* (19 *pp.*) *Received July*, 1930. *Nature*, 126. *pp.* 17–28, *July* 5, 1930. *Supplement.*

A useful summary of the recent work on single crystals of metals.

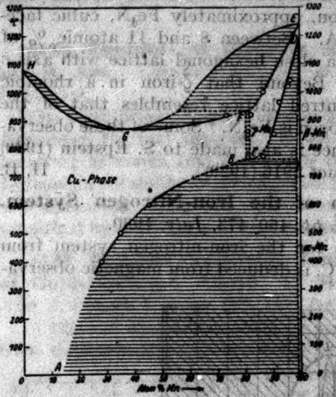
F. J. W.

4136. Method of Obtaining a Single Crystal of Aluminium of Any Desired Crystallographic Orientation. T. Sano. *Kyoto Coll. Sci., Mem.* 13. *pp.* 307–309, *July*, 1930. *In English.*

An easy method of obtaining a metallic single crystal with any desired crystallographic orientation is described, the experiment being made with aluminium. It is confirmed that, when a piece of aluminium is brought into contact with another piece of the same metal, the single crystal does not develop across the boundary between the two pieces so long as the heating is in air and at temperatures lower than the melting point of the metal. AUTHOR.

4137. X-Ray Analysis of the Copper-Manganese Alloys. E. Persson. *Zeits. f. phys. Chem.* 9. *Abt. B.* 1. *pp.* 25–42, *July*, 1930.

The thermal equilibrium diagram for the copper-manganese alloys is established by X-ray analysis of quenched specimens. When alloyed with copper the face-centred tetragonal γ modification of manganese can be retained at ordinary temperatures by quenching. As the copper content of this phase increases the axial ratio approaches unity, so that at 83 atomic % Mn the lattice parameter is identical with that of the face-centred cubic lattice of the saturated solid solution of manganese in copper. There is no experimental evidence for the intermediate two-phase field shown in the diagram at FC, and it is possible that there is a continuous transition from the γ-manganese to the copper phase. α-manganese (stable below 742° C.) and β-manganese (stable from 742° C. to 1191° C.) have only slight solubility for copper. In the homogeneous copper phase the lattice parameter increases rapidly with the first additions of manganese, but beyond 50 atomic % increasing the manganese content has practically no effect on the parameter until the limit of the phase is reached. The volume per atom of the alloys in the copper phase and γ-manganese phase is considerably larger than would correspond to the simple mixture rule.



A. J. M.

4138. Recrystallisation. G. Tammann. *Zeits. f. Metallkunde*, 22. *pp.* 224–226; *Disc.*, 217–220, *July*, 1930.

In crystal recovery of a metal from the fused state, fine grains are formed which grow into crystallites. When a soft metal is hardened by cold work the crystallites are broken up by gliding over one another, friction increases and other changes occur which may be connected with the three conditions of the atoms: atoms not affected by the gliding which have retained their natural potential; atoms in the slip planes of higher potential; and atoms at the intersection of two slip planes of twice higher potential. Thus a deformed crystal resembles a mixed crystal, but the different kinds of atoms pass continuously into one another. Heated hard copper still reflects light at 300° C. like the hard metal, though the elongation is already increased. Even at 600° the orientation of the crystallites is not yet random as it is later when large crystals have formed. The intercrystalline cement of oxide and silicate, which treatment with acid can isolate, first prevents the growth of the crystallites. Cold work changes the structure of these intercrystalline films. When with the displacement of the boundaries two crystal-faces or planes come together which are not equivalent, an abnormal field of force is set up which tends to become normal, and the two crystallites will pass into one another as soon as the temperature is sufficiently high to make the molecules mobile. A single crystal has a lower thermodynamical potential than the conglomerate which therefore tends to turn into a single crystal. Increase in grain size depends upon the orientation of the crystallites and the concentration of the impurities. A second recrystallisation may yield larger crystals because there is less of the cement present. With a low rate of cooling the mass remains more saturated with impurities and the grain is smaller. In a melt of homogeneous temperature the centres of crystallisation are in random distribution, and as the centres develop independently of one another the grain size varies according to the average law of Gauss. In recrystallisation the increase of grain size is not independent of the size of the neighbouring grains, and the average size follows Maxwell's distribution law. H. B.

4139. Atomistic Basis of Recrystallisation. U. Dehlinger. *Zeits. f. Metallkunde*, 22. *pp.* 221–223; *Disc.*, 217–220, *July*, 1930.

An attempt to deduce the movements of the atoms from the rates of recrystallisation. When copper is rolled down and then reheated, recrystallisation is slow at 180 and 190° C., but rapid at 200°. The electric resistance and other properties change more suddenly with temperature. Röntgen examination of cold-worked metals shows that single crystals are broken up into small grains, but that the separate lattices are little changed. The author suggests that the lattices are hooked together, as in Prandtl's model of elastic hysteresis [see Abstract 2036 (1928)], and that the outer atoms will be slightly displaced when the inner atoms still retain their positions. The bond is of the nature of a potential which varies periodically and may push an atom forward or backward when a temperature-rise supplies the energy. The loosened bonds allow the union of separate lattices to larger groups. This takes place slowly at low temperature and rapidly when a certain temperature is exceeded. Impurities may raise or lower that temperature. Thus the presence of a few parts per thousand of iron lowers the crystallisation temperature of silver to room-temperature, whilst copper raises it by 100° C. The calculations are analogous to those for the determination of the Curie point from the ferromagnetic theory of Weiss. H. B.

4140. Nature of Recrystallisation Germs. A. E. van Arkel. *Zeits. f. Metallkunde*, 22. *pp.* 217–220; *Disc.*, 227–229, *July*, 1930.

The number of germs and the rate of recrystallisation depend upon the temperature, composition and history of the material. Apart from the formation of allotropic modifications, recrystallisation occurs in single crystals of elementary metals, only after a definite degree of deformation and after heating to a definite temperature. But the minimum deformation is not a constant quantity. Aluminium of fine grain will recrystallise after an elongation of 3 %, which leaves single crystals of coarser grain unaffected. Torsion and compression have the same effect as stretching, in which the germ number seems to be connected with the strengthening rather than with the elongation. A small, undeformed crystal surrounded by deformed crystals seems to be able to act as germ and to grow at the expense of the latter. When a single crystal is punctured or struck at some spot, a halo of crystals form around it; but these crystals lose the power of growing when slightly deformed [see also Abstract 3582 (1930)]. According to van Liempt, new lattices form spontaneously at spots of greatest disturbance where an excess of deformation energy has accumulated. The transition from germ to crystal core marks a change into a state of lower energy. Similar considerations apply to the formation of allotropic modifications. Reference is also made to the surface-crystallisation of alterthum [see Abstract 2953 (1930)]. H. B.

4141. Influence of a Soluble Fluoride on the Corrosion of Iron. A. W. Chapman. *Chem. Soc., J. pp.* 1546–1550, *July,* 1930.

Aqueous solutions of KF of concentration less than 0·8 *N* corrode a sample of particular iron foil in a manner similar to KCl solutions of equivalent concentration. Unlike the corresponding chloride solutions, however, KF solutions of concentration equal to or above 0·85 *N* do not corrode the foil and exert an inhibiting influence on the corrosive action of chloride ions, this influence being attributed to the formation of a protective film of a fluoride or double fluoride of iron on the surface of the metal. The attack of a dilute fluoride solution is inhibited by sodium carbonate or potassium chromate in concentrations much lower than is needed for a chloride, the fluoride ion being apparently less able to penetrate the protective film formed on the metal by the inhibitor. T. H. P.

4142. Reactions of Excited Mercury Atoms with Hydrogen and with Water. H. Beutler and E. Rabinowitsch. *Zeits. f. phys. Chem.* 8. *Abt. B.* 5–6. *pp.* 403–426, *July,* 1930.

The bands of HgH were observed as fluorescence, after the addition, firstly of H_2O and secondly of $H_2 + N_2$, to an irradiated mercury resonance vessel. In the first case the band heads were most conspicuous and in the second the tails [see Abstract 3891 (1930)]. The formation of HgH is ascribed to the two following reactions of metastable Hg atoms: $Hg(2^3P_0) + H_2O = HgH + OH - 0 \cdot 1$ volts, and $Hg(2^3P_0) + H_2 = HgH + H + 0 \cdot 62$ volts. The first reaction takes place about once in about 3000 collisions, and gives HgH molecules with small rotations, with a maximum at about 4 rotational quanta; the second takes place with about eight times the sectional area of the kinetic theory of gases, and gives strongly rotating HgH molecules (about 20 quanta). The unstable (2^3P_1)Hg atoms have little to do with the production of the HgH. The difference in the rotation of the HgH molecules produced in the two processes remains unaltered until they are excited by the process $HgH + Hg' = HgH' + Hg$, so that when radiation takes place, as indicated by $HgH' = HgH + h\nu$, the difference in the rotation for the two cases can be recognised in the band spectre emitted. H. N. A.

4143. Composition and Conditions of Formation of Active Nitrogen. Z. Bay and W. Steiner. *Zeits. f. phys. Chem.* 9. *Abt. B.* 2. *pp.* 93–127, *July,* 1930.

Spectroscopic investigation leads to the conclusion that active nitrogen is initially a mixture of atoms and metastable molecules [see Abstract 3193 (1929)], the proportions of which are determined by the electrical conditions of excitation (capacity and current characteristics). The exact definition of active nitrogen therefore requires a more precise statement of the conditions of activation. Addition of hydrogen increases the proportion of metastable molecules. Besides its specific chemical effects in the removal of nitrogen atoms by hydrogen atoms, the hydrogen also reduces the average electron velocity in the activating discharge, and thus favours those excitation processes which lead, not to the breaking down of molecules, but to a metastable state. Through these two effects of the hydrogen the metastable molecules preponderate over the atoms as active product in the active nitrogen drawn off from the discharge. The life-period of the metastable molecules is estimated to be in the order of 10^{-1} sec. A. J. M.

4144. Change in Area and Catalytic Activity of Metallic Surfaces on Passing from the Solid to the Liquid State. F. P. Bowden and E. A. O'Connor. *Roy. Soc., Proc.* 128. *pp* 317–329, *July* 1, 1930.

In an earlier paper [see Abstract 646 (1929)] it has been shown that the quantity of electricity which must be passed across the electrode/electrolyte interface in order to cause a given change in the electrode potential is determined by the accessible area of the electrode and is to a first approximation independent of the chemical nature of the surface. This conclusion which had been reached from the results of experiments on mercury and liquid amalgams has now been confirmed, using electrodes of molten gallium and Wood's metal. Further, on solidification the accessible area increases in both cases; for solidified alloy *ca* 1·4 and for solidified gallium *ca* 1·7 times its apparent area. The catalytic activity of the electrode surfaces has been studied by measuring the rate at which they catalyse the rate of evolution of hydrogen; *i.e.*, by measuring the current density. It is shown that the activity of an electrode surface depends upon three factors: (i) the accessible area of the surface, (ii) the configuration of the surface atoms, and (iii) the chemical nature of the metal. These three factors have been separated and the part played by each measured. F. J. W.

4145. Studies in Coordination. Parts I (Amended) and II. F. J. Garrick. *Phil. Mag.* 10. *pp.* 76–80, *July*, 1930.

Part I (amended) contains a correction for one of the equations used in a previous paper [see Abstract 2356 (1930)] which should read: $\mathrm{F_E} = p \cdot \frac{\partial \mathrm{E}}{\partial r} = -\frac{2zep}{r^3} + \Sigma_{k=1}^{k=(n-1)} p^2/\mathrm{S}_\mathrm{K}^4 \,.\, 3(1 + \cos^2\theta)\cos\theta$. The effect of the correction is to establish that the coordination number of rubidium is definitely 8 and that the agreement between Sidgwick's rule and theory is now complete. Part II considers ion-ammoniates from which the following coordination numbers are deduced: Mg^{2+}, 4; Na^+, K^+, Ca^{2+}, and Sr^{2+}, 6; Rb^+, Cs^+ and Ba^{2+}, 8. Exceptions to Sidgwick's rule are Mg^{2+} and Sr^{2+}, but it is shown that a direct appeal to observation is useless, since in solution the ammines of these ions are too much dissociated for their formulæ to be determined, while in dealing with solid ammines it is necessary to know their crystal structure. The condition of ammines in solution is discussed at length. H. H. Ho.

4146. Combustion Reactions in the Hydrogen-Oxygen Flame. E. H. Riesenfeld and E. Wassmuth. *Zeits. f. phys. Chem.* 149. *Abt. A.* 1–2. *pp.* 140–152, *July*, 1930.

The various steps which take place in the combustion of hydrogen and oxygen were investigated by means of a micro-burner. The flame was obtained in an atmosphere of hydrogen and of oxygen. The formation of hydrogen-peroxide as one of the products of combustion as an intermediate step in the reaction was proved. The quantity of hydrogen-peroxide formed in the hydrogen-oxygen flame is one molecule of hydrogen-peroxide to one thousand of water. The presence of ozone in the products of combustion is considered to be due to the decomposition of hydrogen-peroxide. F. J. B.

4147. Dielectric Strengths of Some Explosive Mixtures Containing Carbonic Oxide. B. W. Bradford and G. I. Finch. *Chem. Soc., J. pp.* 1540–1546, *July*, 1930.

The electrical ignition of an explosive gaseous mixture is determined by the establishment of a certain definite concentration of ions at some point within the body of the gas, this being determined by the passage through the mixture of a definite current, termed the least igniting current. If the source of the electrical energy is an induction coil or magneto, the maximum current flows during the first half of the oscillatory, though frequently fully damped, capacity component. In these circumstances it is the capacity and not the inductance component which causes ignition; the maximum current passed by the capacity component, and likewise the energy associated therewith, are determined by the dielectric strength of the gaseous medium traversed by the discharge. Experimental data are given which show that drying with phosphoric oxide increases the dielectric strength of a detonating $2CO + O_2$ mixture, that small additions of hydrogen reduce but do not inhibit this effect and that successive small additions of water vapour at first reduce and then increase the dielectric strength of such gas previously dried over sulphuric acid. Smithells, Whitaker and Holmes' conclusion that hydrogen is more effective than water vapour in conferring ignitability on the gaseous mixture [*Chem. Soc.*, J. p. 185, Feb., 1930)] is shown to be a *non sequitur.* T. H. P.

4148. Chain Reactions Produced by Light and by α-Radiation. H. N. Alyea. *Am. Chem. Soc., J.* 52. *pp.* 2743–2745, *July*, 1930.

When benzene saturated with chlorine is subjected to α-radiation, each ion pair formed results in the production of about 720 mols. of hexachlorobenzene, and in the oxidation of sodium sulphite in solution by oxygen, every ion pair yields about 5000 mols. of sodium sulphate. These results, together with those previously obtained for the hydrogen-chlorine combination and for the synthesis of phosgene from carbon monoxide and chlorine [see Abstract 3595 (1930)] indicate, that, in these four photochemical chain reactions, α-particle bombardment gives rise to chains instead of ion cluster reactions. Many other photochemical chain reactions would doubtless give analogous results, and emphasis is laid on the use of the above method as a means of identifying and studying chain reactions. T. H. P.

4149. Theory of Solution of Metals. M. Straumanis. *Zeits. f. phys. Chem.* 148. *Abt. A.* 5. *pp.* 349–360, *June*, 1930.

The solution of a zinc anode was studied and it was found that, as solution took place, the potential of the electrode diminished as the current strength was increased. The hydrogen evolved during the anodic solution was measured, and the volumes expressed as cc. per sq. cm. of anode area, and the potential of the electrode during the evolution of the gas was measured. From the difference observed in the potential of the anode during solution, and from calculations based upon the difference between the hydrogen evolved at the different potentials, the theory of the "differential effect" was developed. The theory was also developed from the theory of local currents. The conditions which cause the fall of potential of a working electrode were investigated; current strength, overvoltage, and form of electrode had the largest influences. [See also Abstract 491 (1928).] F. J. B.

4150. E.M.F. Measurements with Calcium Chloride Solutions. G. Scatchard and R. F. Tefft. *Am. Chem. Soc., J.* 52. *pp.* 2265–2271, *June*, 1930.

The e.m.f. of the cell Ag/AgCl, $CaCl_2$ (0·1M, aq.), $CaHg_x$, $CaCl_2(m)$, AgCl/Ag was measured at 25° C., with varying concentrations from 0·01 to 1·0 mol. in water to 25 molecular percents in ethyl alcohol. The Debye theory was applied to the results. In aqueous solutions the potential of the calcium amalgam electrode decreased slightly with increasing rate of flow. In mixtures of alcohol and water the potential rapidly increased with increasing rates of flow, and accurate measurements were not possible when the alcohol concentration was large. F. J. B.

4151. E.M.F. Measurements with Zinc Chloride. G. Scatchard and R. F. Tefft. *Am. Chem. Soc., J.* 52. *pp.* 2272–2281, *June*, 1930.

Measurements on the cell ZnHg (2 phase), $ZnCl_2(m)$, AgCl, Ag were made at 25° C. in which *m* was varied from 0·003M to 1·048M. Measurements on barium chloride agreed with the Debye-Hückel equation, assuming complete ionisation. The measurements on zinc chloride did not agree, nor did lead chloride nor cadmium iodide. By assuming the incomplete dissociation of the primary ion a degree of agreement was obtained. The effect of incomplete dissociation, the values of the standard cell potentials, and the activity coefficients were calculated. The relation of apparent association to the "higher terms" and to the deformability of the ions was discussed. F. J. B.

4152. Electrode Potential of Indium. S. Hakomori. *Am. Chem. Soc., J.* 52. *pp.* 2372–2376, *June*, 1930.

Precise measurements of the potential of cells of the type $In/InCl_3$ + HCl/AgCl/Ag were made at a temperature of 25° C., and at concentrations of InCl ranging from 0·0015 to 0·0274 molal. The results indicated that the electrode potential of In/In^{+++} was 0·336 volt referred to the normal hydrogen electrode. This places indium very near to thallium in the electromotive series, and between cadmium and tin or lead. F. J. B.

4153. Oxidation-Reduction Potentials. Part II. Manganese Dioxide Electrode. S. Popoff, J. A. Riddick and W. W. Becker. *Am. Chem. Soc., J.* 52. *pp.* 2624–2632, *July*, 1930.

In order to determine the oxidation-reduction potential of the permanganate-hydrogen-manganous ion electrode, which cannot be measured directly, a series of measurements was made with cells containing permanganate ions and manganese dixoide, and with manganese ions and manganese dioxide. The e.m.f. was measured against the hydrogen electrode. The results showed that pure manganese dioxide could not be prepared electrolytically, but contained lower oxides of manganese. When pure manganese dioxide was employed in the manganese dioxide-hydrogen-manganous electrode, the electrode was found to be irreversible. It was evident that the potential of the permanganate-hydrogen-manganous electrode could not be calculated from the potentials of the manganese dioxide electrodes. Details for the exact determination of manganese gravimetrically are given. [See also Abstract 2028 (1929).] F. J. B.

4154. Potential of the Copper Electrode. F. H. Getman. *J. Phys. Chem.* 34. *pp.* 1454–1465, *July*, 1930.

The potential of an electrode formed of a single crystal of pure metallic copper is found to be 3·5 millivolts higher than the potentials of a series of copper-amalgam electrodes. The normal potential of the two forms of electrode is estimated to be — 0·3498 volt for copper amalgam electrodes, and — 0·3475 for the copper-crystal electrode. The activity coefficients of solutions of copper sulphate are calculated from the foregoing values of the electrode potentials, and are compared with the values obtained from freezing-point data. The similarity in behaviour of mono-crystalline and spongy copper is briefly discussed. F. J. B.

4155. Overvoltage of Hydrogen and Adsorption of Ions. P. Herasymenko and I. Šlendyk. *Zeits. f. phys. Chem.* 149. *Abt. A*, 1–2. *pp.* 123–139, *July*, 1930.

A series of measurements of the deposition potential of hydrogen on a dropping mercury electrode were made. The results confirmed the theory put forward by Heyrovsky, if allowance was made for the adsorption of ions. It was found that neutral salts displaced the hydrogen ions from the surface layer of the kathode, and so influenced the overvoltage. The effect depended upon the nature of the added kations, and similar effects to the coagulation of negative colloids by the addition of electrolytes were observed. A general relationship between the potentials of deposition of hydrogen and the composition of the solution is developed, which is in harmony with the experimental results. F. J. B.

4156. Overvoltage of Hydrogen. E. Baars and C. Kayser. *Zeits. f. Elektrochem.* 36. *pp.* 428–439, *July*, 1930.

An experimental investigation of the overvoltage of kathodic evolution of hydrogen was made at low current densities. Measurements were made with electrodes of mercury, lead, copper, gold and platinum, so as to obtain the greatest differences in the behaviour of the electrodes. The results show that the overvoltage in the electrolytic evolution of hydrogen is always conditioned by a certain finite current density. There is no evidence of a minimum value for the overvoltage. Earlier observations of the existence of this minimum were shown to be due to residual current phenomena. The diffusion of hydrogen and oxygen to the electrodes also play a part. F. J. B.

4157. E.M.F. of the Hydrogen Electrode in Organic Acids. N. Isgarischew and S. A. Pletenew. *Zeits. f. Elektrochem.* 36. *pp.* 457–460, *July*, 1930.

The paper is a preliminary communication of certain results obtained in the study of the e.m.f. of the hydrogen electrode in organic acids. The e.m.f. was determined in pure acetic acid and in butyric acid, in the presence of increasing quantities of sodium acetate, and of water. A steady rise of e.m.f. was found with the increase of concentration of the added substances. F. J. B.

4158. Influence of Light on the Magnitude of Oxygen Depolarising Currents. L. W. Haase. *Zeits. f. Elektrochem.* 36. *pp.* 456–457, *July*, 1930.

The behaviour of cells consisting of iron and platinum, and of cadmium and platinum electrodes, in potassium chloride solution as electrolyte is studied. The effect of illuminating the electrodes by diffused daylight, sunlight and magnesium light is determined. It was found that a lower current was obtained in the dark than in the light and the difference was considered to be due to the depolarisation of the oxygen electrode. F. J. B.

4159. General (Exact) Equation to the Potentiometric-Titration Curve. B. Cavanagh. *Chem. Soc., J. pp.* 1425–1447, *June*, 1930.

A generalisation of the potentiometric-titration curve equation which was derived from thermodynamic grounds, and was described in a previous paper [see Abstract 2236 (1928)], is developed. It is shown that the equation is applicable to a system involving both analytical and electrode reactions of the most general type. A routine procedure is described and allowances made for unavoidable variations in the subsidiary conditions, such as volume of the solution and the concentrations of the subsidiary reactants and products. A simple method for corrections for unavoidable fluctuations of temperature is also developed. F. J. B.

4160. New Type of Triode for the Determination of Hydrogen-Ion Concentration. G. B. Harrison. *Chem. Soc., J. pp.* 1528–1534, *July*, 1930.

A method of determining H-ion concentrations using glass electrodes and a triode valve is developed. Glass membranes are made by blowing bulbs of a special glass at the end of a narrow tube, and the membrane is protected by a glass guard. The chief characteristic of the valve requisite for the measurements is an extremely low grid current. A Cambridge potentiometer and a sensitive galvanometer are used to measure the e.m.f. The method is capable of general use, and possesses high accuracy. F. J. B.

4161. Preparation of Pure Hydrogen by Means of a Palladium Electrolytic Osmoregulator. H. Hulubei. *Comptes Rendus*, 191. *pp.* 134–136, *July* 21, 1930.

In order to introduce pure hydrogen into an enclosure an electrolytic osmoregulator constructed of palladium, with walls 0·1 mm. thick, is attached thereto. To hydrogenate the palladium a solution of phosphoric acid is electrolysed with a current of 5–20 mA., the palladium being made kathode with a platinum anode so arranged as to give a uniform field around the tube. The hydrogen is liberated when desired by gentle heat. C. A. S.

4162. Dissociation of Strong Electrolytes. Parts I and II. M. B. Jacobs and C. V. King. *J. Phys. Chem.* 34. *pp.* 1013–1020, *May, and pp.* 1303–1309, *June*, 1930.

Part I deals with optical rotation and the theory of complete dissociation. It is shown that comparatively few optically strong electrolytes behave in such a way that rotation data can be interpreted in favour of complete dissociation except as a limiting condition at high dilution. Those who have claimed that such data support the theory of complete dissociation have apparently gone no further than to requote the data Noyes quoted in 1904, on the optical activity of one acid and its salts. Optical rotation data offer little (if any) support for the theory at present. Part II considers two-phase equilibria and heats of neutralisation. The validity of the following evidence is discussed: (1) the extremely low vapour pressure of the hydrogen halides above their dilute aqueous solutions; (2) the experiments of Hill on the extraction of silver perchlorate from benzene by water; and (3) the supposed equality of the heats of neutralisation of strong acids and bases. It is shown that these data do not support a theory of complete dissociation in preference to one of partial dissociation. H. H. Ho.

4163. Incompatibility between any Theory of Complete Dissociation and Migration Data. J. W. McBain and P. J. van Rysselberge. *Am. Chem. Soc., J.* 52. *pp.* 2336–2347, *June*, 1930.

Migration data were obtained for mixtures of magnesium and rubidium sulphates, ammonium and potassium iodides, potassium and sodium chlorides, and for mixtures of potassium and sodium nitrates. The concentrations of the various solutions were such that one of the two sulphates was present in a very large amount compared with the other. The result showed that in solutions of 0·05M magnesium or rubidium sulphates the addition of a large proportion of other sulphates caused the magnesium or rubidium to migrate away from the kathode toward the anode. In a mixture of ammonium iodide containing an excess of potassium iodide, the movement of the ammonium may be practically suppressed. In mixtures of potassium chloride with excess of sodium chloride, or of potassium nitrate with excess of sodium nitrate, the movement of the potassium may be considerably decreased. From the experiments the conclusion was drawn that strong electrolytes form undissociated molecules and complex anions and differ only in degree from the extreme case such as cadmium iodide. F. J. B.

4164. Transference Phenomena and Magneto-Chemical Behaviour of Complex Ions. S. Freed and C. Kasper. *Am. Chem. Soc., J.* 52. *pp.* 2632–2638, *July*, 1930.

The magnetic susceptibility of mixtures of ammonium sulphate and manganese sulphate was determined. It was found that the susceptibility of the manganous ion in the presence and absence of ammonium sulphate was identical within the limits of experimental error. Transference measurements showed that the same concentration was obtained in the unchanged centre and anode portions after 17 milliamperes had been passed for four and also for ten hours. The results showed that a metallic ion which does not form negative complex ions can show a net migration to the anode. The exhibition of such migration is no proof of the formation of complex ions. F. J. B.

4165. Surface Conductivity of Solutions of Electrolytes. J. W, McBain and C. R. Peaker. *J. Phys. Chem.* 34. *pp.* 1033–1040, *May*. 1930.

Continuing experiments in which the existence of surface conductivity near the boundary of optically polished glass and solutions of potassium chloride was shown [see Abstracts 1149 and 1679 (1930)], a new cell was used in which the capillary spaces were provided by using a number of concentric pyrex tubes which telescoped into one another. Resistances are given of solutions of potassium chloride, barium chloride, potassium sulphate, potassium ferrocyanide and aluminium chloride. The results obtained bear out the conclusions previously reached with polished surfaces that surface conductivity exists and must be considered when dealing with equilibria in capillary spaces. The conductivity of solutions of various electrolytes is greater in capillaries than in bulk, and the relative increase in conductivity is greater the more dilute the solution; moreover, the specific surface conductivity decreases as the concentration decreases. The values found for the specific surface conductivity of KCl are higher than those formerly obtained with optically polished surfaces, but they can be brought into agreement by assuming that the actual surface area of ordinary pyrex tubing is two and a quarter times greater than that determined by macroscopic measurements. J. J. S.